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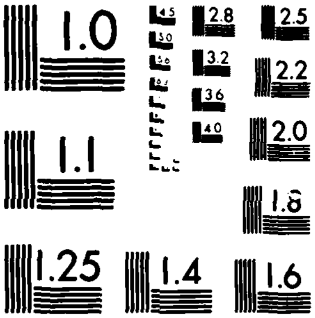

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IDA PAPER P-1879

USER'S MANUAL FOR THE PROTOTYPE Ada* COMPILER EVALUATION CAPABILITY (ACEC) VERSION 1

Audrey A. Hook
Gregory A. Riccardi
Michael Vilot
Stephen Welke

October 1985

Prepared for
Office of the Under Secretary of Defense for Research and Engineering

IDA
INSTITUTE FOR DEFENSE ANALYSES
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This Paper has been reviewed by IDA to assure that it meets high standards of thoroughness, objectivity, and sound analytical methodology and that the conclusions stem from the methodology.

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The purpose of the Prototype Ada Compiler Evaluation Capability (ACEC) is to provide users with 1) an organized suite of compiler performace tests, and 2) support software for executing these tests and collecting performance statistics. These performance tests were collected by the Ada Evaluation and Validation (E&V) Team from several sources. The test programs, which have been in the public domain for some time, have been organized as a test suite according to categories which are explained in Section II. The strategy for measuring test performance and obtaining differential statistics is described in Section III. Section IV describes the entire support software architecture, including machine-dependent modules. General instructions for executing the Prototype ACEC are provided in Section V.

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ATTRIBUTION

The User's Manual was prepared by the IDA team who developed the Prototype ACEC. The members of this team were:

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TABLE OF CONTENTS

PROTOTYPE ADA COMPILER EVALUATION CAPBABILITY
VERSION 1

USER'S MANUAL

SECTION I: INTRODUCTION

The purpose of the Prototype Ada Compiler Evaluation Capability (ACEC) is to provide users with 1) an organized suite of compiler performance tests, and 2) support software for executing these tests and collecting performance statistics. These performance tests were collected by the Ada Evaluation and Validation (E&V) team from several sources. The test programs, which have been in the public domain for some time, have been organized as a test suite according to categories which are explained in Section II (Appendix A is a listing of the names and descriptions of all the tests in the test suite). They have also been instrumented to provide execution statistics. The user can obtain differential execution statistics for the Ada language feature(s) used in a test by comparing different versions of the test. The strategy for measuring test performance and obtaining differential statistics is described in Section III.

The support software that is provided with the system consists of Ada packages (see Appendix B). This software includes an interface to a database of test attributes, an instrumentation package designed to collect execution statistics, and a report writer. All of these packages should run on any hardware host. However, to make the Prototype ACEC complete, there are host/target machine-dependent modules that a user must provide as part of the support software. These modules are required in order to collect the compilation and run-time statistics that are only available through the operating system and/or software monitors for that machine. The entire support software architecture, including the machine-dependent modules, is described in Section IV.

The intended users of this system will be programmers who are familiar with their Ada compilation system. They must know how to invoke the compiler and host/target dependent portions of the Prototype ACEC. A user who is familar with the Ada Compiler Validation Capability (ACVC) should find that the Prototype ACEC is roughly equivalent in execution complexity to the ACVC; however, the number of tests to be executed by the

Prototype ACEC is an order of magnitude less than the number in the ACVC. General instructions for executing the Prototype ACEC are provided in Section V.

Several general concepts are useful for understanding the significance of the measurements that can be obtained from the Prototype ACEC. The current view of compiler evaluation tests is similar to the concept of benchmarks designed to demonstrate the performance characteristics of a computer system when it is used for processing a typical workload. Benchmarks are programs, or sets of programs, that are used to represent a real workload; therefore, they are a synthetic workload which may or may not accurately represent the future capacity and efficiency requirements for a specific application. Typically, benchmark programs provide general measurements of execution efficiency and are used to indicate the relative capabilities of different computer systems or alternative configurations. On the other hand, the Prototype ACEC allows the user to measure the effect of specific workloads on a particular computer system component, the compiler.

The design goal for the Prototype ACEC was to collect objective, quantifiable attributes of an Ada compiler/run-time combination that would allow an applications developer to evaluate the usefulness of a compiler for a future application. The usefulness of a compiler is a function of the language constructs that are most frequently used (i.e. required) by an application and the effect that they produce in demand for computer resources. These most frequently used language constructs are the "stress load" for a compiler which, in turn, may have the effect of a "bottleneck" in the computer system configuration. Since applications differences lead to remarkably different frequency distributions of language features, the Prototype ACEC was designed to allow a user to select tests for specific constructs and to obtain consistent measurements for the "costs" (e.g. time and space) associated with these constructs when they are used in various compiler/run-time combinations.

Therefore, the Prototype ACEC provides a user with two options for evaluating an Ada compiler. A user may select a set of tests which represents the frequency distribution of language constructs in a real application; or, the user may execute all tests to gain some insight regarding the language feature(s) which could be a stress load for a compiler/run-time combination, if these features were among the most frequently used. HOWEVER, PROTOTYPE ACEC MEASUREMENTS ARE ONLY AN INDICATION OF THE EFFECT PRODUCED BY AN ADA LANGUAGE FEATURE WHEN IT IS USED IN A PARTICULAR COMPILER/RUN-TIME COMBINATION. THESE MEASUREMENTS ARE NOT ABSOLUTE PERFORMANCE METRICS OF THE EFFICIENCY OF A PARTICULAR COMPILER ARCHITECTURE.

SECTION II: TEST CATEGORIES AND ATTRIBUTES

This section discusses the architecture categories that have been established for the Prototype ACEC test suite and the attributes of these tests which are available through the support software. The attributes of each test unit are keyed to the category and sub-category classification of that test.

A. ARCHITECTURE CATEGORIES

Test units have been organized into two major groups based upon the information that the test unit will provide to the user. The first group of tests will provide information about language features that must be present in a compiler if it is a full implementation of the ANSI/MIL-STD 1815A. Therefore, these tests are called "normative" since they will produce the lowest level of measurement statistics that can be collected to characterize the performance of a conforming compiler. The second group of tests will provide information about combinations of language constructs and/or compiler features that may be of interest to applications developers. These tests are called "optional." These two major categories, normative and optional, have been further sub-divided based upon the type of measurements that can be derived from the tests. A description of each category and sub-category is given below:

A.1 NORMATIVE

Normative tests will provide a means for determining the system cost for a particular language feature. The user should execute all normative tests to obtain a quantitative indication of the usefulness of a compiler. There are two types of tests in the normative category:

A.1.1 Sub-category: PERFORMANCE

Performance tests will collect speed and space attributes for various Ada language features.

A.1.2 Sub-category: CAPACITY

Capacity tests will indicate the limitations imposed by the compiler and the run-time system on applications developers (e.g. levels of recursion, size of stack, etc.). Note that these tests may overlap with the ACVC, class D t϶sts.

A.2 OPTIONAL

Optional tests may be selected by a user to represent an applications profile consisting of most frequently used language features. They have been included in the Prototype ACEC test suite to provide measurements which are consistent with normative tests.

A.2.1 Sub-category: FEATURES

Features tests provide measurements of optional language features (features which are not a required part of an Ada compiler). They also provide measurements of the effects of certain compiling options. Refer to Chapter 13 of the Ada LRM for examples of optional language features.

A.2.2 Sub-category: SPECIAL ALGORITHMS

Special algorithms tests are combinations of language constructs that are characteristic of synthetic benchmark programs. They include such widely known benchmarks as Whetstone and the Sieve of Eratosthenes.

B. TEST ATTRIBUTES

For each test there are attributes, including an architecture category as described above, that provide a user with descriptive information about that test. These attributes are stored in a database of test names, and are available via the report writer. They can also be used as search criteria for selecting a set of tests with a specified attribute (see Appendix C under the description of the "LIST" option). The attributes are listed below:

B.1 DESCRIPTION - A description of the test objective.

B.2 ARCHITECTURE CATEGORY - Code indicating membership in a major test category and a particular sub-category.

B.3 E&V CRITERIA - The evaluation criteria for this test, according to the list developed by the E&V Team. Only certain Efficiency criteria were found to be applicable.

B.4 LANGUAGE FEATURE - The language feature(s) being tested. The Prototype ACEC does not cover all of the Ada language features.

B.5 VERSION - Identification of whether this is the test or the control program, or the test with an optimization feature (see Section III).

B.6 STATISTICS TYPE - A description of the kind of statistics being collected (Compilation, Execution, or Both).

SECTION III: DATA COLLECTION AND EVALUATION

The individual Ada main procedures that comprise the Prototype ACEC test suite were adapted from test programs that have been in the public domain for some time.(*) Each of these procedures (a test unit) can provide compilation and execution statistics. The ability to collect data is determined by the facilities of the host/target environment and the Ada support software in the Prototype ACEC.

Figure 1 (see page 7) shows the data collection scheme for a single test. The figure indicates the location of clock measurements used to derive the various elapsed and cpu times. Also shown are the possible size measurements of objects created or used in compiling and executing a test. Note that only the instrumentation elapsed time is calculated by the provided software; all other statistics must be determined by some host/target dependent mechanisms. (See Section IV and Appendix B for a description of the support software functionality and interface specifications for the host/target environment.)

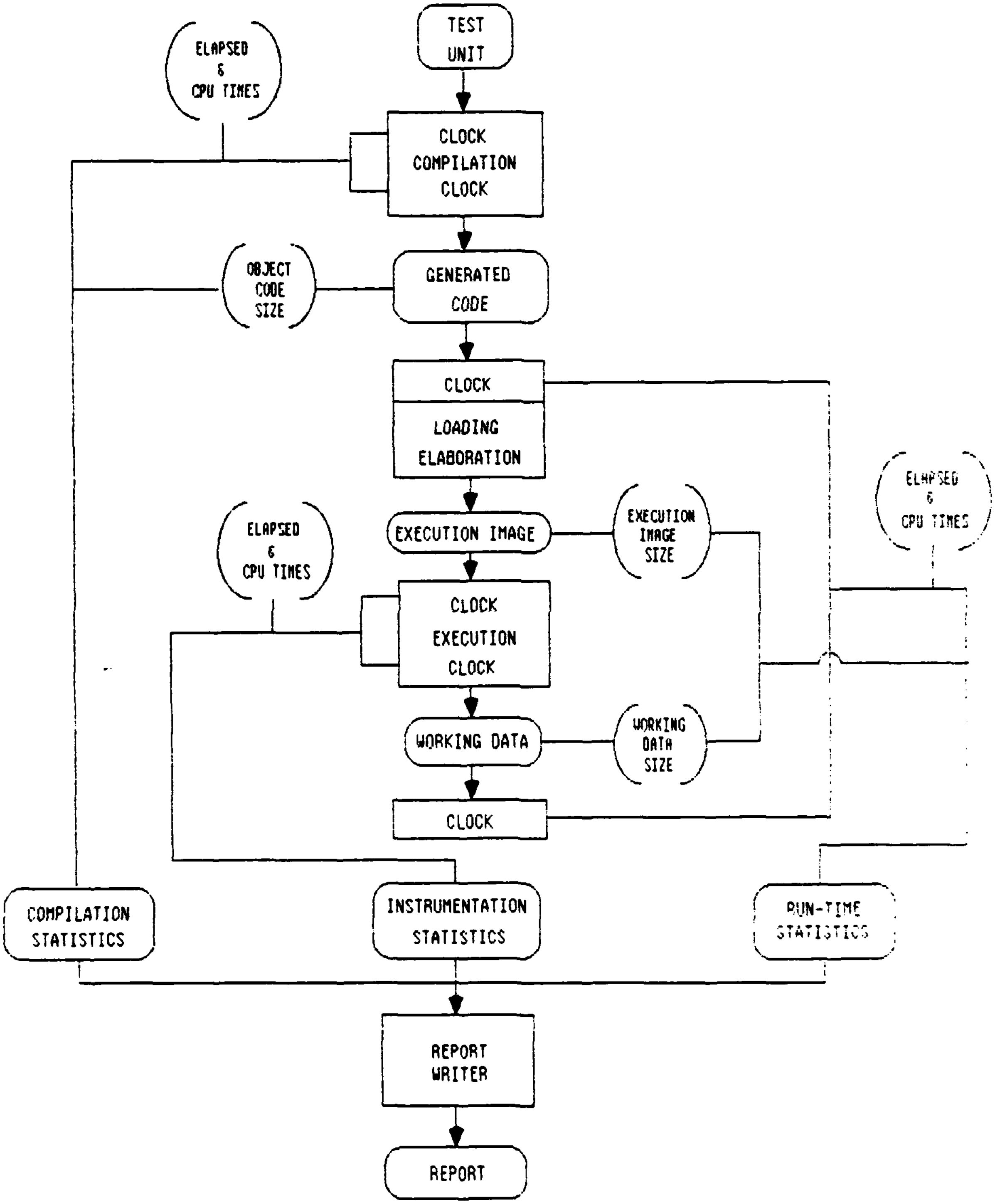
The data collected for an individual test is not of much use unless used in a differential strategy which filters out aspects of compilation and execution that are not caused by the specific feature under evaluation. To make this strategy possible, most tests have more than one version. The first version, the control, is structured like the other versions of the test, but does not contain the specific feature being tested. The other versions (there may be only one) of the test contain the language feature, with or without various optimizations. Once the data for at least two versions has been collected, a statement can be made about the feature under test.

For instance, suppose the control version of an integer addition test takes 0.15 seconds to execute, while version 2 of the same test, the test version, takes 0.25 seconds to execute. This would indicate that the execution overhead for having the integer additions was 0.10 seconds. If version 3, with the PRAGMA SUPPRESS, executed in 0.23 seconds, it could be said that 0.02 seconds were saved by use of this optimization. This same type of differential measurement strategy is used on the other time and size data to form conclusions about the time and space "costs" of the Ada language feature being tested.

(*) These original tests were written by many people with different styles and objectives. Minimal changes were made to these tests to adapt them to the test suite architecture. New tests were not written for this Prototype ACEC.

Figure 1

Test Data Collection



SECTION IV: SOFTWARE ARCHITECTURE

The Prototype ACEC consists of several software components, some of which are provided in Ada source code, and some of which are necessarily implementation-dependent. Figure 2 (see page 9) is a representation of the software components and their interrelation.

In reference to Figure 2, the software components provided as Ada source code are the database package, the report writer, the instrumentation package, and the set of benchmark tests. The database package and the instrumentation package are not Ada main programs; rather, they are library packages. The database package is intended primarily for use by the report writer, but is available for use by the selector as well. In contrast, the instrumentation package is intended for use solely by the benchmark test programs themselves. The report writer and the benchmark tests are Ada main programs. The report writer, database package, and instrumentation package are described in more detail below. Instructions for executing the support software are provided in Section V.

The Database Package:

The database package provides basic facilities to retrieve information about a named benchmark test. The information available through the database package corresponds to the attributes described in Section II. Included are a one-line description of the test, the architecture category that the test falls under, the E&V Criteria that the test provides information about, the language feature(s) that the test examines, the version of the test that this particular program represents, and an indication of what statistics are expected to be collected for this test. This package is contained in the file DATABASE.ADA and depends on the library package(s) contained in the files LIST_PACKAGE.ADA and SCHEMA.ADA.

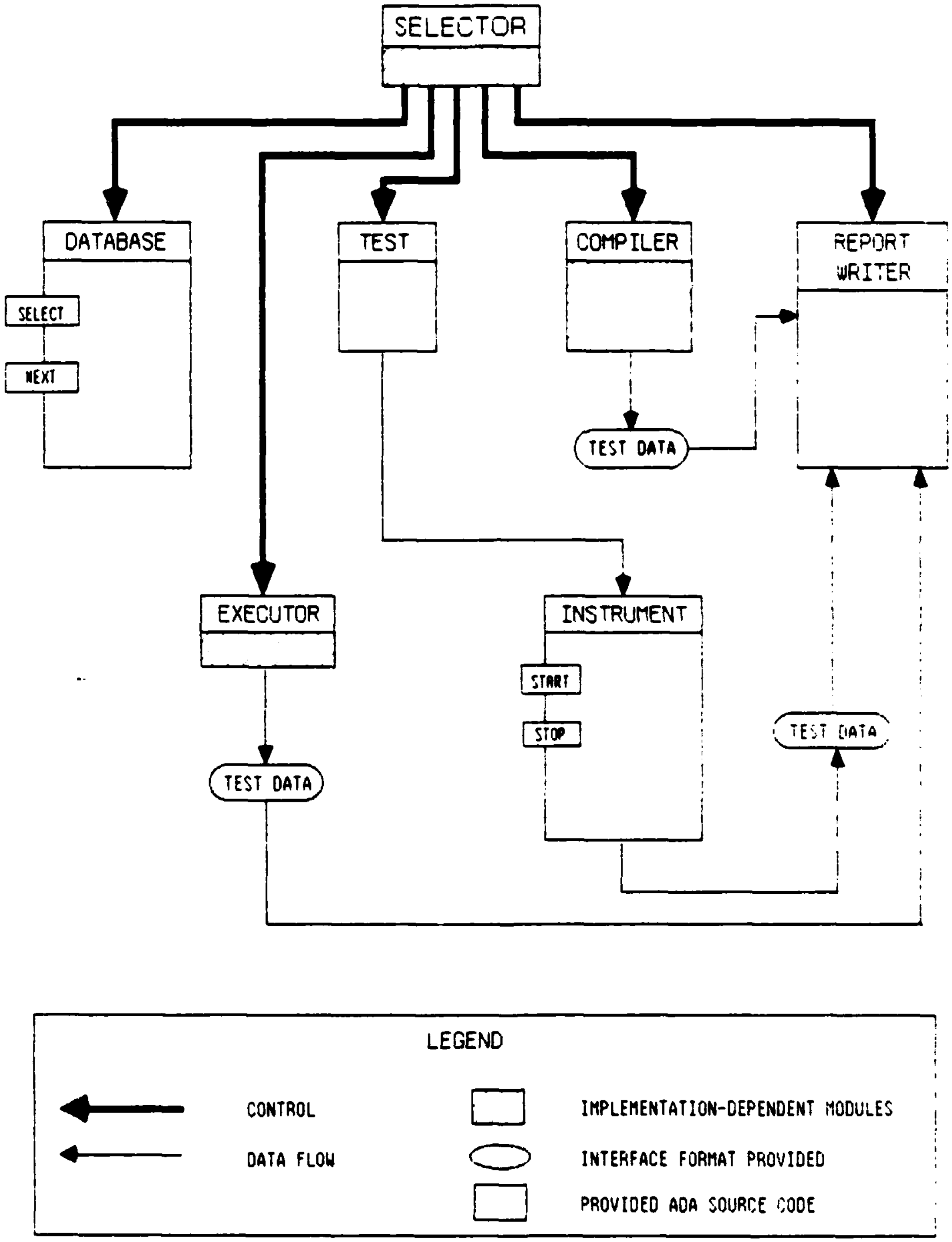
The Instrumentation Package:

The instrumentation package provides a simple start-stop timing facility based on the built-in clock capabilities of the Ada package CALENDAR. This facility determines the total time that has elapsed during execution. The instrumentation package also provides a package CPU_TIME.ADA for collecting the cpu time used during execution.

The CPU_TIME.ADA package that comes with the system contains a dummy function called CPU_CLOCK that returns the value 0.0. In order to collect meaningful results, the user will have to replace the dummy CPU_CLOCK with a new CPU_CLOCK function that accesses the system accounting information. However, this replacement is not required; the system will function properly with the dummy function.

Figure 2

Software Architecture



The instrumentation package is not intended for use outside of the test suite. It is contained in the file INSTRUMENT.ADA and depends on the library package(s) contained in the file IO_PACKAGE.ADA.

The Report Writer:

The report writer is the visible interface to the user. Its function is to report both collected statistics and desired database attributes. A detailed explanation of the report writer and how to use it is given in Appendix C. The report writer is contained in the files INQUIRY.ADA and REPORT_WRITER.ADA. In addition, it depends on the library package(s) contained in the files DATABASE.ADA, ATTRIBUTE.ADA, and IO_PACKAGE.ADA.

Figure 3 (see page 11) presents the compilation dependencies of the packages provided with the test suite.

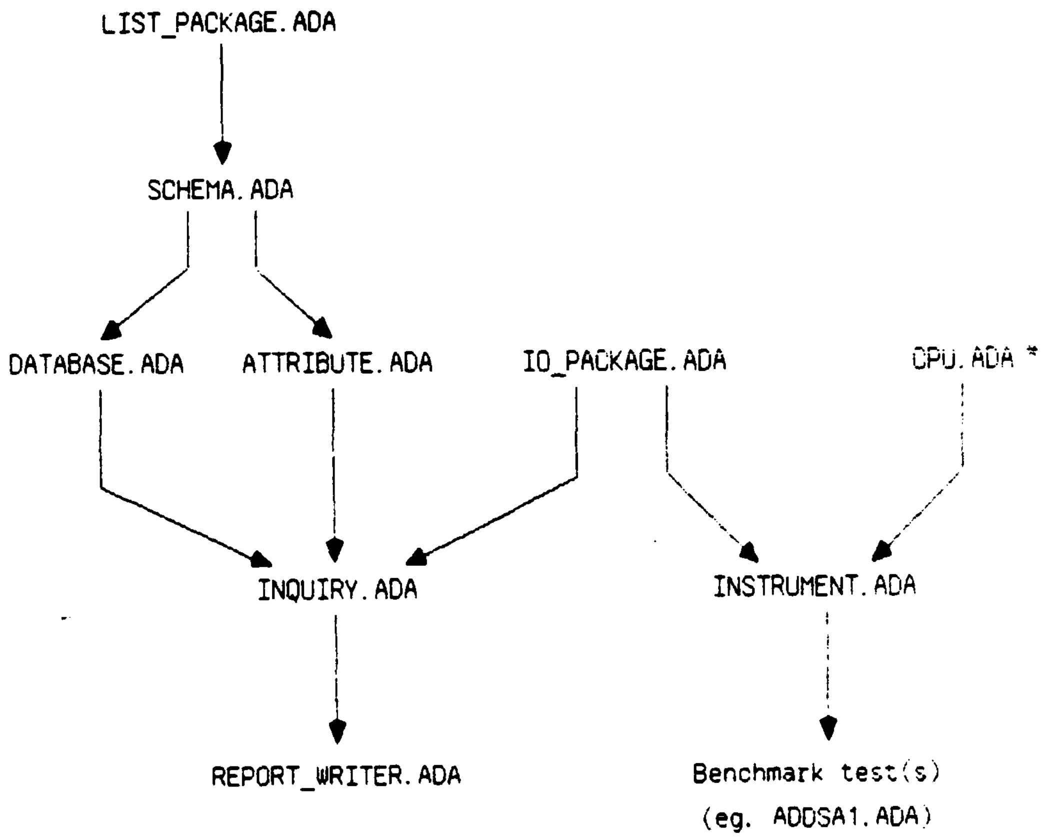
The remaining software (the compiler, the executor and the selector) is necessarily machine-dependent, and must be provided by the user. In reference to Figure 2, the compiler is that set of software that compiles a single benchmark test and stores the collected compilation statistics in a file. Similarly, the executor is that set of software that executes a single test and stores the collected run-time statistics in a file. Interface specifications for formatting the collected data, if this data is available, are given in Section V. The selector is the overall "system manager" that chooses tests to be run and operates the compiler and executor. It makes the compilation and run-time statistics files available to the report writer. As mentioned previously, the selector may also be used to access the database directly.

Typically, the selector will consist of both software and human input. For our example on the MV10000 AOS/VS system, we chose the tests ourselves, and ran a test harness to manage the running of the compiler and executor. The test harness also reformatted the system accounting information to comply with the interface specifications required by the report writer. The term "test harness" refers to the portion of the selector that sends tests through the compiler and executor. Test harness examples are provided in Appendix D.

The executor is the series of system specific commands needed to execute a compiled program and collect the resulting statistics. In environments where host and target are different machines, this sequence of steps can be quite complex.

Figure 3

Compilation Order



* See Section IV under the description of "The Instrumentation Package"

Note: In order to compile a particular package, the package(s) pointing to it must be compiled first.

SECTION V: EXECUTION INSTRUCTIONS

This section of the User's Manual provides basic instructions for executing the Prototype ACEC system. These instructions will help the users to 1) identify the software modules that must be produced, 2) become aware of the various options within the system, and 3) gain an overall view of how this evaluation system works.

The system specific test harness mentioned in Section IV processes the benchmark tests and collects system resource statistics. On most systems, the test harness will consist of one or more operating system command files that will compile and execute each test program.

Different operating systems make various accounting information available to their users. This information can be an important part of the evaluation statistics gathered by the benchmarks. The statistics which are generated can be captured and stored in text files. These files, if available, will become input to the report writer. The format for each of these text files - the "TEST DATA" blocks in Figure 2 (see page 9) - is specified in Figure 4. NOTE: The user-defined filenames must be EXACTLY six characters long.

With these interface files well defined, the portable report writer software will be able to report as much data as can be collected by the host and target environments. On those systems where such accounting information is unavailable or difficult to obtain, the report writer will still function (although the lack of statistics will seriously degrade the usefullness of the Prototype ACEC system).

The Compilation Statistics:

Compilation statistics may be available from the compiler that is being evaluated, or they may be available from host system accounting information. In either case, there must be some host-dependent software to convert the statistics into the file format expected by the report writer. Figure 4a (see page 13) defines this format. These statistics must be appended onto a user-defined compilation file after each test is compiled. If parts of this information are not available, dummy values (such as 0) must be placed in the file in order for the report writer to use the file.

The Instrumentation Statistics:

Each test program utilizes an instrumentation package which reports the elapsed execution time of the test program. This data is collected from the function CLOCK of package CALENDAR.

Figure 4

Formats of the Statistics Files

For all three of the statistics files, each line of the file contains a sequence of fields separated by one or more spaces:

(a) The Compilation—Time Statistics File

1. Test name (6 characters)
2. Total elapsed time, in seconds *
3. Total cpu time, in seconds *
4. Object code size, in bytes **
5. Comments, a string of (up to) 120 characters

(b) The Instrumentation Statistics File

1. Test name (6 characters)
2. Total elapsed time, in seconds *
3. Total cpu time, in seconds *
4. Comments, a string of (up to) 120 characters

(c) The Run—Time Statistics File

1. Test name (6 characters)
2. Total elapsed time, in seconds *
3. Total cpu time, in seconds *
4. Execution image size, in bytes **
5. Working data size, in bytes **
6. Comments, a string of (up to) 120 characters

* The report writer currently displays these real numbers with an accuracy of 1/100th of a second

** Integer numbers

If available, CPU time can also be reported by modifying the package CPU_TIME which is provided in the support software. This package contains the function CPU_CLOCK which can be replaced to return the execution cpu time using some host/target dependent facility. (The CPU_CLOCK function that is provided returns the dummy value 0.0). This data is automatically written onto a file named "INSTR" at the end of the execution of the test program. NOTE: The contents of this file ("INSTR") MUST be appended onto a user-defined instrumentation file after each test program is run. The instrumentation file format is shown in Figure 4b (see page 13).

The Run-time Statistics:

These statistics are meant as a supplement to the instrumentation statistics. Run-time statistics are collected and properly formatted by host/target dependent mechanisms. Again, these statistics must be appended onto the user's run-time statistics file after each test program is run. Uncollectable data must be entered as dummy values in the run-time file. The format of this file is given in Figure 4c (see page 15).

Performing the Evaluation:

To start the evaluation process, the Ada code for the support software must be compiled onto an Ada library. Figure 3 (see page 11) gives the compilation order. Next, the user may develop the command files (the test harness) to help execute the ACEC system. Once the full test harness is ready, tests can be compiled and executed with all the generated statistics being captured in text files. After any number of test programs have been processed, the report writer should be executed with the collected data files as input. The report writer and the test harness can be re-run any number of times and in any order to produce the final evaluation report(s).

APPENDIX A: TEST SUITE - LISTING OF TESTS

This is a list of the benchmark tests that are currently in the database. Included are the test names and descriptions. The test names in the database are the same as the file names containing the Ada main programs.

Each test name has three parts. The first four characters describe the test characteristic. Where possible, these four characters are organized into a mnemonic (i.e. SIEV => Sieve of Eratosthenes). Otherwise, an acronym has been constructed (i.e. BRUA => Block Reference to an Uplevel variable, Access type). The fifth character is a letter that represents a difference in the number of occurrences of the test characteristic. For example, LAVRA1 performs one local array variable reference, while LAVRB1 performs ten references. The sixth character is the version number. Version 1 is the control version and version 2 is the test version. The other versions (3, 4, etc.) test for the effects of certain compiler features (i.e. PRAGMAs).

ADDSA1	10_000 floating pt. Additions (control)
ADDSA2	10_000 floating pt. Additions (test)
ADDSA3	10_000 floating pt. Additions (pragma suppress)
AKERA2	Ackermann function (test)
AKERA3	Ackermann function (pragma suppress)
AOCEA1	Arith. Optimization, Const. Elim. (control)
AOCEA2	Arith. Optimization, Const. Elim. (test)
AOIEA1	Arith. Optimization, Invariant Elim. (control)
AOIEA2	Arith. Optimization, Invariant Elim. (test)
ASSIA2	500 ASSIGNMENT STMTS (1 PER LINE)
ASSIA3	500 ASSIGNMENT STMTS (5 PER LINE)
ASSIA4	500 ASSIGNMENT STMTS INTERJECTED WITH COMMENTS
ASSIA5	500 ASSIGNMENT STMTS PRECEEDED BY 500 COMMENTS
ASSIB2	1000 ASSIGNMENT STMTS INTERJECTED WITH COMMENTS
BALPA1	EVALUATES THE EFFICIENCY OF A SIMPLE LOOP STATEMENT (CONTROL)
BALPA2	THIS TEST EVALUATES THE EFFICIENCY OF A SIMPLE LOOP STATEMENT (TEST)
BLEMA2	65 EMBEDDED BLOCKS
BRUAA1	Block Ref. to an Uplevel var., Access type (control)
BRUAA2	Block Ref. to an Uplevel var., Access type (test)
BRUNA1	Block Ref. to an Uplevel var., Non-access type (control)
BRUNA2	Block Ref. to an Uplevel var., Non-access type (test)
BSRCA2	TEST BINARY SEARCH PKG AT EXTREME LIMITS OF ITS INDEX TYPE: LOWER
BSRCA3	TEST BINARY SEARCH PKG AT EXTREME LIMITS OF ITS INDEX TYPEE: UPPER
C31PA2	CHECKS THAT 31 PARAMETERS CAN BE PASSED
CAPAA1	Constrained Array Param. Assoc. w/3 elements (control)

CAPAA2	Constrained Array Param. Assoc. w/3 elements (test)
CAPAB1	Constrained Array Param. Assoc. w/63 elements (control)
CAPAB2	Constrained Array Param. Assoc. w/63 elements (test)
CASEA2	CHECKS A CASE STAMTEMENT OF SIZE 256
CENTA2	CHECKS AN ENUMERATION TYPE OF 256 ELEMENTS
CENTB2	CHECKS ENUMERATION TYPES UP TO 2000 ELEMENTS
CHSSA1	Char. String Search (control)
CHSSA2	Char. String Search (test)
CHSSA3	Char. String Search (pragma suppress)
CSBTA1	Case Statement Binary Test (control)
CSBTA2	Case Statement Binary Test (test)
CSCTA1	Case Statement Cluster Test (control)
CSCTA2	Case Statement Cluster Test (test)
CSDTA1	Case Statement Dense Test (control)
CSDTA2	Case Statement Dense Test (test)
CSETA1	Case Statement Exhaustive Test (control)
CSETA2	Case Statement Exhaustive Test (test)
CSSTA1	Case Statement Sparse Test w/range 1..5 (control)
CSSTA2	Case Statement Sparse Test w/range 1..5 (test)
CSSTB1	Case Statement Sparse Test w/range 1..20 (control)
CSSTB2	Case Statement Sparse Test w/range 1..20 (test)
CSSTC1	Case Statement Sparse Test w/range 1..50 (control)
CSSTC2	Case Statement Sparse Test w/range 1..50 (test)
CSSTD1	Case Statement Sparse Test w/range 1..500 (control)
CSSTD2	Case Statement Sparse Test w/range 1..500 (test)
CSSTE1	Case Statement Sparse Test w/range 1..5000 (control)
CSSTE2	Case Statement Sparse Test w/range 1..5000 (test)
DRPCA1	Direct Recursive Procedure Call (control)
DRPCA2	Direct Recursive Procedure Call (test)
F1IUA1	EFFICIENCY OF LOOP STMT,FOR,LOOP PARAM USED IN LOOP BODY (CONTROL)
F1IUA2	EFFICIENCY OF LOOP STMT, FOR, LOOP PARAM USED IN LOOP BODY
FACTA1	RECURSIVE FACTORIAL FUNCTION (CONTROL)
FACTA2	RECURSIVE FACTORIAL FUNCTION
FL2RA1	EFFICIENCY OF A FOR LOOP STMT , REVERSE, 2 ITERATIONS (CONTROL)
FL2RA2	EFFICIENCY OF A LOOP STMT USING FORR, REVERSE, 2 ITERATIONS
FLP1A1	EVALUATES THE EFFICIENCY OF A LOOP STMT USING FOR, 1 ITER. (CONTROL)
FLP1A2	EVALUATES THE EFFICIENCY OF A LOOP STMT USING FOR, 1 ITERATION
FLP2A1	EVALUATES THE EFFICIENCY OF A LOOP STMT USING FOR, 2 ITER. (CONTROL)
FLP2A2	EVALUATES THE EFFICIENCY OF A LOOP STMT USING FOR, 2 ITERATIONS
FPAAA1	Formal in/out Param. Assoc. w/1 param., Access type (control)
FPAAA2	Formal in/out Param. Assoc. w/1 param., Access type (test)
FPAAB1	Formal in/out Param. Assoc. w/2 param., Access type (control)
FPAAB2	Formal in/out Param. Assoc. w/2 param., Access type (test)

FPAAC1	Formal in/out Param. Assoc. w/5 param., Access type (control)
FPAAC2	Formal in/out Param. Assoc. w/5 param., Access type (test)
FPAAD1	Formal in/out Param. Assoc. w/10 param., Access type (control)
FPAAD2	Formal in/out Param. Assoc. w/10 param., Access type (test)
FPANA1	Formal in/out Param. Assoc. w/1 param., Non-access type (control)
FPANA2	Formal in/out Param. Assoc. w/1 param., Non-access type (test)
FPANB1	Formal in/out Param. Assoc. w/2 param., Non-access type (control)
FPANB2	Formal in/out Param. Assoc. w/2 param., Non-access type (test)
FPANC1	Formal in/out Param. Assoc. w/5 param., Non-access type (control)
FPANC2	Formal in/out Param. Assoc. w/1 param., Non-access type (test)
FPAND1	Formal in/out Param. Assoc. w/10 param., Non-access type (control)
FPAND2	Formal in/out Param. Assoc. w/10 param., Non-access type (test)
FPRAA1	Formal in/out Parameter Ref., Access type (control)
FPRAA2	Formal in/out Parameter Ref., Access type (test)
FPRNA1	Formal in/out Parameter Ref., Non-access type (control)
FPRNA2	Formal in/out Parameter Ref., Non-access type (test)
GVRAA1	Global Var. Ref., Access type (control)
GVRAA2	Global Var. Ref., Access type (test)
GVRNA1	Global Var. Ref., Non-access type (control)
GVRNA2	Global Var. Ref., Non-access type (test)
IADDA1	Integer Addition (control)
HSDRA2	HEAPSORT BENCHMARK TEST DRIVER USES XOBMHSPK
IADDA2	Integer Addition (test)
IDIVA1	Integer Division (control)
IDIVA2	Integer Division (test)
IEXPA1	Integer Exponentiation (control)
IEXPA2	Integer Exponentiation (test)
IMIXA1	Integer Mixed Expressions 01 (control)
IMIXA2	Integer Mixed Expressions 01 (test)
IMIXB1	Integer Mixed Expressions 02 (control)
IMIXB2	Integer Mixed Expressions 02 (test)
IMIXC1	Integer Mixed Expressions 03 (control)
IMIXC2	Integer Mixed Expressions 03 (test)
IMIXD1	Integer Mixed Expressions 04 (control)
IMIXD2	Integer Mixed Expressions 04 (test)
IMIXE1	Integer Mixed Expressions 05 (control)
IMIXE2	Integer Mixed Expressions 05 (test)
IMODA1	Integer Modulus (control)
IMODA2	Integer Modulus (test)
IMULA1	Integer Multiplication (control)
IMULA2	Integer Multiplication (test)

IREMA1	Integer Remainder (control)
INTDA2	CHECKS 150 INTEGER DECLARATIONS
INTDB2	500 DECLARATION STMTS FOR INTEGER
INTDB3	500 DECLARATION STMTS FOR INTEGER (10 PER LINE)
INTQA2	TEST A FULL INTEGER QUEUE USING XOQUE PACKAGE
IREMA2	Integer Remainder (test)
ISEQA2	TEST GENERIC SEQUENCE MANIPULATION PACKAGE, 50 INTEGERS
ISUBA1	Integer Subtraction (control)
ISUBA2	Integer Subtraction (test)
LAVRA1	1 Local Array Var. Ref. (control)
LAVRA2	1 Local Array Var. Ref. (test)
LAVRB1	10 Local Array Var. Ref. (control)
LAVRB2	10 Local Array Var. Ref. (test)
LFIRA1	Loop Fuse, Index Ref. (control)
LFIRA2	Loop Fuse, Index Ref. (test)
LFSRA1	Loop Fuse, Scalar Ref. (control)
LFSRA2	Loop Fuse, Scalar Ref. (test)
LOAEA1	Loop Optimization, Asst. Eval. (control)
LOAEA2	Loop Optimization, Asst. Eval. (test)
LOECA1	Loop Optimization, Expr. Calc. (control)
LOECA2	Loop Optimization, Expr. Calc. (test)
LOFCA1	Loop Optimization, Function Call (control)
LOFCA2	Loop Optimization, Function Call (test)
LONEA1	Loop Optimization, Nested Expr. comp. (control)
LONEA2	Loop Optimization, Nested Expr. comp. (test)
LOSCA1	Loop Optimization, Subscript Calc. (control)
LOSCA2	Loop Optimization, Subscript Calc. (test)
LOUIA1	Loop Optimization, Unroll Index ref. (control)
LOUIA2	Loop Optimization, Unroll Index ref. (test)
LOUSA1	Loop Optimization, Unroll Scalar ref. (control)
LOUSA2	Loop Optimization, Unroll Scalar ref. (test)
LRR1A1	First-level Local Record var. Ref. (control)
LRR1A2	First-level Local Record var. Ref. (test)
LRR2A1	Second-level Local Record var. Ref. (control)
LRR2A2	Second-level Local Record var. Ref. (test)
LRR3A1	Third-level Local Record var. Ref. (control)
LRR3A2	Third-level Local Record var. Ref. (test)
LVRAA1	1 Local Var. Ref., Access type (control)
LVRAA2	1 Local Var. Ref., Access type (test)
LVRAB1	10 Local Var. Ref., Access type (control)
LVRAB2	10 Local Var. Ref., Access type (test)
LVRNA1	1 Local Var. Ref., Non-access type (control)
LVRNA2	1 Local Var. Ref, Non-access type (test)
LVRNB1	10 Local Var. Ref., Non-access type (control)
LVRNB2	10 Local Var. Ref., Non-access type (test)
MINIA2	MIMIMAL PROGRAM WITH 1 STMT , 1 DECLARATION
MTCQA2	TEST EMPTY CHARACTER QUEUE USING XOQUE PACKAGE
MTESA2	TEST EMPTY SET OF ENUMERATION TYPE USING XOSET PACKAGE
MTISA2	TEST EMPTY SET OF INTEGERS USING XOSET PACKAGE
MULTA1	10_000 floating pt. Multiplications (control)
MULTA2	10_000 floating pt. Multiplications (test)
MULTA3	10_000 floating pt. Multiplications (pragma suppress)

NL00A1	Overhead for Nested Loops - NO loops (control)
NL07A2	Overhead for 7 Nested Loops (test)
NL65A2	Overhead for 65 Nested Loops (test)
NPPCA1	No Parameter Procedure Call (control)
NPPCA2	No Parameter Procedure Call (test)
NRPCA1	Nested Recursive Procedure Call (control)
NRPCA2	Nested Recursive Procedure Call (test)
NULLA1	NULLPROCEDURE (CONTROL)
NULLA2	CALL TO NULL PROCEDURE
OPAEA1	Optimization Perf., Arith. Elim. (control)
OPAEA2	Optimization Perf., Arith. Elim. (test)
OPBFA1	Optimization Perf., Bool. Folding (control)
OPBFA2	Optimization Perf., Bool. Folding (test)
OPCEA1	Optimization Perf., Call Elim. (control)
OPCEA2	Optimization Perf., Call Elim. (test)
OPCFA1	Optimization Perf., Constant Folding (control)
OPCFA2	Optimization Perf., Constant Folding (test)
OPDSA1	Optimization Perf., Distributed Simp. (control)
OPDSA2	Optimization Perf., Distributed Simp. (test)
OPISA1	Optimization Perf., Identity Simp. (control)
OPISA2	Optimization Perf., Identity Simp. (control)
OPLEA1	Optimization Perf., Load Elim. (control)
OPLEA2	Optimization Perf., Load Elim. (test)
OPNFA1	Optimization Perf., Num. Folding (control)
OPNFA2	Optimization Perf., Num. Folding (test)
OPSCA1	Optimization Perf., Subscript Calc. (control)
OPSCA2	Optimization Perf., Subscript Calc. (test)
OPSEA1	Optimization Perf., Store Elim. (control)
OPSEA2	Optimization Perf., Store Elim. (test)
PGQUA2	TEST PUT_END AND GOT_END WITH AN ENUMERATED TYPE USING XOQUE PKG
PIALA2	PI Algorithm (test)
PKGEA1	EACH PACKAGE BODY FOLLOWS DIRECTLY AFTER THE PKG SPEC (CONTROL)
PKGEA2	EACH PACKAGE BODY FOLLOWS DIRECTLY AFTER THE PKG SPEC
PKGSA1	PACKAGE BODY SEPARATED FROM PACKAGE SPEC. (CONTROL)
PKGSA2	PACKAGE BODY SEPARATED FROM PACKAGE SPEC
PRCOA2	PRODUCER/CONSUMER PROBLEM
PRPCA1	Parallel Recursive Procedure Call (control)
PRPCA2	Parallel Recursive Procedure Call (test)
PRUAA1	Proc. Ref. to an Uplevel var., Access type (control)
PRUAA2	Proc. Ref. to an Uplevel var., Access type (test)
PRUNA2	Proc. Ref. to an Uplevel var., Non-access type (test)
PRUNA1	Proc. Ref. to an Uplevel var., Non-access type (control)
SIEVA1	Sieve of Eratosthenes (control)
PUZZA2	PUZZLE
PUZZA3	PUZZLE (PRAGMA SUPPRESS)
RANDA2	RANDOM NUMBER GENERATOR
RCDSA2	CHECKS 400 FIELD RECORDS
RENDA1	SIMPLE RENDEZVOUS (CONTROL)
RENDA2	SIMPLE RENDEZVOUS
SHARA2	READERS/WRITERS PROBLEM

SIEVA2	Sieve of Eratosthenes (test)
SORTA2	TEST INSERTION SORT USING XOSORT PACKAGE
SQ10A2	PUT 10 INTEGERS IN SEQUENCE AND TEST IF EMPTY USING XOSEQ PACKAGE
SQPGA2	PUT AND GET 10 INTEGERS IN SEQUENCE USING XOSEQ PACKAGE
SRCRA1	Simple Record Component Ref. (control)
SRCRA2	Simple Record Component Ref. (test)
SRTEA1	Simple Record Type Elaboration (control)
SRTEA2	Simple Record Type Elaboration (test)
TAIPA1	Task Perf. w/1 element Array 'in' Param. (control)
TAIPA2	Task Perf. w/1 element Array 'in' Param. (test)
TAIPB1	Task Perf. w/32 element Array 'in' Param. (control)
TAIPB2	Task Perf. w/32 element Array 'in' Param. (test)
TAIPC1	Task Perf. w/64 element Array 'in' Param. (control)
TAIPC2	Task Perf. w/64 element Array 'in' Param. (test)
TAIPD1	Task Perf. w/320 element Array 'in' Param. (control)
TAIPD2	Task Perf. w/320 element Array 'in' Param. (test)
TAIPE1	Task Perf. w/640 element Array 'in' Param. (control)
TAIPE2	Task Perf. w/640 element Array 'in' Param. (test)
TAIPF1	Task Perf. w/3200 element Array 'in' Param. (control)
TAIPF2	Task Perf. w/3200 element Array 'in' Param. (test)
TAIPG1	Task Perf. w/6400 element Array 'in' Param. (control)
TAIPG2	Task Perf. w/6400 element Array 'in' Param. (test)
TAOPA1	Task Perf. w/1 element Array 'in out' Param. (control)
TAOPA2	Task Perf. w/1 element Array 'in out' Param. (test)
TAOPB1	Task Perf. w/32 element Array 'in out' Param. (control)
TAOPB2	Task Perf. w/32 element Array 'in out' Param. (test)
TAOPC1	Task Perf. w/64 element Array 'in out' Param. (control)
TAOPC2	Task Perf. w/64 element Array 'in out' Param. (test)
TAOPD1	Task Perf. w/320 element Array 'in out' Param. (control)
TAOPD2	Task Perf. w/320 element Array 'in out' Param. (test)
TAOPE1	Task Perf. w/640 element Array 'in out' Param. (control)
TAOPE2	Task Perf. w/640 element Array 'in out' Param. (test)
TAOPF1	Task Perf. w/3200 element Array 'in out' Param. (control)
TAOPF2	Task Perf. w/3200 element Array 'in out' Param. (test)
TAOPG1	Task Perf. w/6400 element Array 'in out' Param. (control)
TAOPG2	Task Perf. w/6400 element Array 'in out' Param. (test)
TPGTA2	Task Perf., Guard Test, 2 guards (test)
TPGTB2	Task Perf., Guard Test, 2 guards (test)
TPGTC2	Task Perf., Guard Test, 20 guards (test)
TPGTD2	Task Perf., Guard Test, 20 guards (test)
TPITA1	Task Performance w/1 Idle Task (control)
TPITA2	Task Performance w/1 Idle Task (test)
TPITB1	Task Performance w/5 Idle Tasks (control)
TPITB2	Task Performance w/5 Idle Tasks (test)
TPITC1	Task Performance w/10 Idle Tasks (control)
TPITC2	Task Performance w/10 Idle Tasks (test)
TPITD1	Task Performance w/20 Idle Tasks (control)
TPITD2	Task Performance w/20 Idle Tasks (test)
TPOTA2	Task Perf., Order Test (test)
TPOTB2	Task Perf., Order Test (test)
TPOTC2	Task Perf., Order Test (test)

TPSTA2	Task Perf., Select test (test)
TPSTB2	Task Perf., Select Test (test)
TPTCA2	Task Perf., Task Chain, lenght 1 (test)
TPTCB2	Task Perf., Task Chain, length 5 (test)
TPTCC2	Task Perf., Task Chain, length 10 (test)
TPTCD2	Task Perf., Task Chain, length 20 (test)
TPUTA2	Task Perf. Unknown Test (test)
TPUTB2	Task Perf., Unknown Test (test)
TPUTC2	Task Perf., Unknown Test (test)
TPUTD2	Task Perf., Unknown Test (test)
TPUTE2	Task Perf., Unknown Test (test)
UAPAA1	Unconst. Array Param. Assoc. w/3 elems. (control)
UAPAA2	Unconst. Array Param. Assoc. w/3 elems. (test)
UAPAB1	Unconst. Array Param. Assoc. w/63 elems. (control)
UAPAB2	Unconst. Array Param. Assoc. w/63 elems. (test)
VFADA1	Vector Floating pt. Addition (control)
VFADA2	Vector Floating pt. Addition (test)
VIADA1	Vector Integer Addition (control)
VIADA2	Vector Integer Addition (test)
VPGSA2	TEST VARIOUS PUTS AND GETS IN SEQUENCE USING XOSEQ PACKAGE
WHETA2	WHETSTONE INSTRUCTIONS WITH FLOATS
WHETA3	WHETSTONE INSTRUCTIONS WITH FLOATS (PRAGMA SUPPRESS)
WHLPA1	EVALUATES THE EFFICIENCY OF A LOOP STATEMENT USING WHILE (CONTROL)
WHLPA2	EVALUATES THE EFFICIENCY OF A LOOP STATEMENT USING WHILE

APPENDIX B : ADA PACKAGES FOR SUPPORT SOFTWARE

The package specifications for all of the Ada packages in the ACEC are provided below.

IO_PACKAGE.ADA specification:

```
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with TEXT_IO;
use  TEXT_IO;

--  This package abstracts I/O operations from the Statistics files
--  defined in LIST_STATISTICS.  It is a consequence of Ada that
--  such procedures must be defined for any structured types.
--  The package encapsulates details about file contents, layout, etc.

package IO_PACKAGE is

-- Constants

  COLUMNS          : constant := 120;
                          -- must = SCHEMA.DESCRIPTION_LENGTH
  UNIT_NAME_LENGTH : constant :=   6;
                          -- must = SCHEMA.NAME_LENGTH
  MAX_FILE_LENGTH  : constant :=  22;

  C_HEADER : constant STRING :=
              " Name           Elapsed/CPU  Code/Data  Comments";
  R_HEADER : constant STRING :=
              " Name   Event   Elapsed/CPU  Code/Data  Comments";
  I_HEADER : constant STRING :=
              " Name   Event   Elapsed/CPU             Comments";

--  Basic types
  type    Choice_Type    is ( START_REC, COM_REC, STOP_REC );
  subtype Name_Type      is STRING( 1..UNIT_NAME_LENGTH );
  subtype Size_Type      is NATURAL;  -- integer bytes
  subtype Comment_Length is NATURAL range 0..COLUMNS;
  subtype File_Name_Type is STRING(1..MAX_FILE_LENGTH);

  BLANK_UNIT_NAME : Name_Type      := ( others => ' ' );
  BLANK_FILE_NAME : File_Name_Type := ( others => ' ' );

--  Structured types
  type File_Record_Type is
    record

       FILE_EXISTS    : BOOLEAN         := FALSE;
```

```
        FILE_NAME     : File_Name_Type  := BLANK_FILE_NAME;

        INTERNAL_NAME : TEXT_IO.File_Type;
    end record;

  type Compilation_Record_Type(LEN : Comment_Length := 0) is
     record
        TEST_NAME         : Name_Type   := BLANK_UNIT_NAME;

        TOTAL_ELAPSED_TIME: DURATION    := 0.0;

        TOTAL_CPU_TIME    : DURATION    := 0.0;

        OBJECT_CODE_SIZE  : Size_Type   := 0;

        COMMENTS          : STRING( 1..LEN ) := (others=>' ');
     end record;

  type Run_Time_Record_Type(LEN : Comment_Length := 0) is
     record

        TEST_NAME         : Name_Type   := BLANK_UNIT_NAME;

        TOTAL_ELAPSED_TIME: DURATION    := 0.0;

        TOTAL_CPU_TIME    : DURATION    := 0.0;

        MEMORY_CODE_SIZE  : Size_Type   := 0;

        MEMORY_DATA_SIZE  : Size_Type   := 0;

        COMMENTS          : STRING( 1..LEN ) := (others => ' ');
     end record;

  type Instrumentation_Record_Type(LEN : Comment_Length :=10) is
    record

        TEST_NAME         : Name_Type   := BLANK_UNIT_NAME;

        IDENT             : Choice_Type := START_REC;

        ELAPSED_TIME      : DURATION    := 0.0;

        ELAPSED_CPU_TIME  : DURATION    := 0.0;

        COMMENTS          : STRING( 1..LEN ) := (others => ' ');
     end record;

-- File I/O Operations

  procedure Get_File_Name(FILE: in out File_Record_Type);
  procedure Open_File(    FILE: in out File_Record_Type;
                          MODE: in     TEXT_IO.FILE_MODE := IN_FILE );
  procedure Close_File(   FILE: in out File_Record_Type );
  procedure File_Status(  FILE: in     File_Record_Type );

-- Compilation I/O

  procedure Get( FILE : in File_Type;
                VALUE : out Compilation_Record_Type );

  procedure Put( FILE : in File_Type:= CURRENT_OUTPUT;
                VALUE : in Compilation_Record_Type );

-- Run Time I/O

  procedure Get( FILE : in File_Type;
                VALUE : out Run_Time_Record_Type );

  procedure Put( FILE : in File_Type:= CURRENT_OUTPUT;
                VALUE : in Run_Time_Record_Type );

-- Instrumentation I/O

      procedure Get( FILE : in File_Type;
                    VALUE : out Instrumentation_Record_Type );

  procedure Put( FILE : in File_Type:= CURRENT_OUTPUT;
                VALUE : in Instrumentation_Record_Type );

end IO_PACKAGE;

-  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -

              LIST_PACKAGE.ADA specification:

-  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -

    generic
  type List_Element is private;
package Singly_Linked_List is
-----------------------------------------------------------------------
-- Abstract   : This package provides an abstraction for a singly linke
-----------------------------------------------------------------------

  type List_Type is private;
  function Empty (List : List_Type) return Boolean;
-- Indicates whether the list contains any elements.
  function Null_Node (List : List_Type) return Boolean;
-- Indicates whether the "current pointer" references an element in
-- the list.
  function Head_Node (List : List_Type) return Boolean;
-- Indicates whether the "current pointer" references the head of
-- the list.
```

```
  function Tail_Node (List : List_Type) return Boolean;
-- Indicates whether the "current pointer" references the tail of
-- the list.
  function Current_Element (List : List_Type) return List_Element;
-- Returns the value of the element referenced by the "current
-- pointer".
-- Raises End_Error if Null_Node(List) = True.
  procedure First (List : in out List_Type);
-- Positions the "current pointer" at the head of the list
-- (even if the list is empty).
  procedure Next (List : in out List_Type);
-- Positions the "current pointer" at the next element in the list.
-- After the last element in the list Null_Node(List) becomes True.
-- Raises End_Error if Null_Node(List) = True.
  procedure Insert_After (List    : in out List_Type;
                          Element : List_Element);
-- Inserts an element after the "current pointer".
-- If Null_Node(List) = True the element is appended after the tail
-- element.
  procedure Insert_Before (List    : in out List_Type;
                           Element : List_Element);
-- Inserts an element before the "current pointer".
-- If Null_Node(List) = True the element is prepended before the
-- head element.
  procedure Delete_Element (List : in out List_Type);
-- Deletes the element referenced by the "current pointer" from
-- the list.
-- Upon deletion, the "current pointer" references the element
-- after the deleted element.
-- Raises End_Error if Null_Node(List) = True.
  generic
    with procedure Transformation (Element : in out List_Element);
  procedure Modify (List : List_Type);
-- Permits modification of the element referenced by the "current
-- pointer" where the modification doesn't require external values
-- (e.g. incrementing a field of the element).
-- Raises End_Error if Null_Node(List) = True.
  generic
    type Update_Information is private;
    with procedure Transformation (Element     : in out List_Element;
                                   Information : Update_Information);
  procedure Update (List        : List_Type;
                    Information : Update_Information);
-- Permits modification of the element referenced by the "current
-- pointer" where the modification requires external values
-- (e.g. assigning a value to a field of the element).
-- Raises End_Error if Null_Node(List) = True.
  pragma Inline (Empty, Null_Node, Head_Node, Tail_Node,
                 Current_Element);
  pragma Inline (Modify, Update);
  End_Error : exception;
```

```
private
  type Node;
  type Node_Access is access Node;
  type Node is
    record
      Element : List_Element;
      Next    : Node_Access;
    end record;
  type List_Type is
    record
      Head     : Node_Access;
      Tail     : Node_Access;
      Previous : Node_Access;
      Current  : Node_Access;
    end record;
end Singly_Linked_List;

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                   SCHEMA.ADA specification:

-  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -

with SINGLY_LINKED_LIST;
package SCHEMA is
  -----------------------------------------------------------------
  -- exports 7 basic types describing test units:
  --  Architecture_Category_Type  -- benchmark category of the test
  --  Description_Type            -- a string describing the test
  --  E_and_V_Criterion_Type      -- the E and V team category of
  --                                 the test.  May be more than one,
  --                                 which is the reason for the
  --                                 List types
  --  Language_Feature_Type       -- the Ada language category of the
  --                                 test.  May also be more than one.
  --  Name_Type                   -- the short name (also file name).
  --  Statistics_Type             -- the priciple kind of statistics
  --                                 measured by the test.
  --  Version_Type                -- the benchmark version of the
  --                                 test.
  --
  -- the rest is there for implementation reasons
  -----------------------------------------------------------------
  type Architecture_Category_Type is (NORMATIVE_PERFORMANCE,
                             NORMATIVE_CAPACITY, OPTIONAL_FEATURE,
                             OPTIONAL_ALGORITHM, EVERY);
--
  DESCRIPTION_LENGTH : constant := 120;  -- see User's Manual
  subtype Description_Type is STRING (1 .. DESCRIPTION_LENGTH);
--
  CRITERION_LENGTH   : constant := 36;
  subtype E_and_V_Criterion_Type is STRING (1 .. CRITERION_LENGTH);
```

```
--
  FEATURE_LENGTH     : constant := 51;
  subtype Language_Feature_Type is STRING (1 .. FEATURE_LENGTH);
--
  NAME_LENGTH        : constant := 6;
  subtype Name_Type is STRING (1 .. NAME_LENGTH);
--
  type Statistics_Type is (COMPILATION, EXECUTION, BOTH);
--
  type Version_Type is (CONTROL,TEST, OPTIMIZE, SUPPRESS, OTHER,
                        ALL_VERSIONS);
  -----------------------------------------------------------------
  -- Lists of E and V Criteria
  -----------------------------------------------------------------
  type E_and_V_Criterion_Abbreviation_Type is (EFFCY01, EFFCY06,
                    EFFCY13, EFFCY18, EFFCY21, EFFCY22, EFFCY26,
                    EFFCY29, EFFCY32);
--
     package CRITERION_LISTS is
        new SINGLY_LINKED_LIST(E_and_V_Criterion_Abbreviation_Type);
     use CRITERION_LISTS;
  type E_and_V_Criteria_List is new CRITERION_LISTS.List_Type;
  function EXPAND( KEY: E_and_V_Criterion_Abbreviation_Type ) return
                      E_and_V_Criterion_Type;
  -----------------------------------------------------------------
  -- Lists of Language Features
  -----------------------------------------------------------------
  type Language_Feature_Abbreviation_Type is
  (IDENTIFIERS,         LITERALS,            DERIVED_TYPES,
   SCALAR_TYPES,        ARRAY_TYPES,         RECORD_TYPES,
   ACCESS_TYPES,        LOCAL_NAMES,         NON_LOCAL_NAMES,
   INDEXED_COMPS,       SLICES,              SELECTED_COMPS,
   ATTRIBUTES,          AGGREGATES,          RECORD_AGGS,
   ARRAY_AGGS,          EXPRESSIONS,         LOGICAL_OPERATORS,
   RELATIONAL_OPERATORS,  BINARY_ADDS,       UNARY_ADDS,
   MULTIPLYING_OPS,     HI_PRECEDENCE_OPS,   TYPE_CONVERSIONS,
   QUALIFIED_EXPRESSIONS,  ALLOCATORS,       STATIC_EXPRS_SUBTYPES,
   ASSIGNMENT,          ARRAY_ASSIGN,        IF_STMTS,
   CASE_STMTS,          LOOP_STMTS,          BLOCK_STMTS,
   EXIT_STMTS,          RETURN_STMTS,        GOTO_STMTS,
   SUBPROGRAM_DECLS,    SUBPROGRAM_CALLS,    PARAMETER_ASSNS,
   DEFAULT_PARMS,       OVERLOADING,         PACKAGE_SPECS_DECLS,
   PACKAGE_BODIES,      PRIVATE_TYPES,       REFERENCES_TO_OBJECTS,
   USE_CLAUSES,         RENAMING_DECLS,      TASK_TYPES_OBJECTS,
   TASK_EXECUTION,      TASK_DEPENDENCE,     ENTRIES_ACCEPTS,
   DELAY_STMTS,         SELECT_STMTS,        SELECTIVE_WAITS,
   CONDITIONAL_ENTRIES,  TIMED_ENTRIES,      TASK_ENTRY_ATTRIBS,
   ABORT_STMTS,         CONTEXT_CLAUSES,     SUBUNITS,
   EXCEPTION_DECLS,     EXCEPTION_HANDLERS,  RAISE_STMTS,
   EXCEPTION_PROPAGATION,  GENERIC_DECLS,    GENERIC_BODIES,
   GENERIC_INSTS,    USES_OF_GENERIC_INSTS,  REPRESENTATION_CLAUSES
   LENGTH_CLAUSES,      ENUM_REP_CLAUSES,    RECORD_REP_CLAUSES,
   ADDRESS_CLAUSES,     CHANGE_OF_REP,       MACHINE_CODE_INSERTS,
   UNCHECKED_PGMING,    SEQ_DIR_FILES,       TEXT_INPUT_OUTPUT,
   PRAGMA_INLINE,       PRAGMA_OPTIMIZE,     PRAGMA_PACK,
   PRAGMA_SHARED,       PRAGMA_SUPPRESS);
   --
     package FEATURE_LISTS is
       new SINGLY_LINKED_LIST(Language_Feature_Abbreviation_Type);
     use FEATURE_LISTS;
  type Language_Features_List is new FEATURE_LISTS.List_Type;
  function EXPAND( KEY: Language_Feature_Abbreviation_Type ) return
                      Language_Feature_Type;
  -----------------------------------------------------------------
  -- Lists of Test Unit Names
  -----------------------------------------------------------------
  package NAME_LISTS is new SINGLY_LINKED_LIST(Name_Type);
  use  NAME_LISTS;
  type Name_List is new NAME_LISTS.List_Type;

end SCHEMA;

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

                 ATTRIBUTE.ADA specification:

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

with SCHEMA;
use  SCHEMA;
package ATTRIBUTE_OPTIONS is

--  LIST_BY_NAME means that attributes will be listed for a
--            single instance of a test file name
--  LIST_BY_CATEGORY means that attributes will be listed for
--            all test files included in the specified attribute

  type Listing_Type   is ( LIST_BY_NAME, LIST_BY_CATEGORY );
  type Attribute_Type is ( SHORT, TEST_NAME, DESCRIPTION,
                           ARCHITECTURE, E_AND_V, LANGUAGE_FEATURE,
                           VERSION, STATISTICS );
  subtype Category_Type  is
                  Attribute_Type range ARCHITECTURE..STATISTICS;

-- These subprograms set and observe the internal state maintained by
--   the package body

  procedure SET_LIST( SWITCH : in Listing_Type := LIST_BY_NAME );
  function  LISTING return Listing_Type;

  procedure   SET( OPTION : in Attribute_Type );
  procedure RESET( OPTION : in Attribute_Type );
  function IS_SET( OPTION : in Attribute_Type ) return BOOLEAN;
  procedure SET_QUERY( VALUE :
                          in Architecture_Category_Type );
  procedure SET_QUERY( VALUE :
                          in E_and_V_Criterion_Abbreviation_Type );
  procedure SET_QUERY( VALUE :
                          in Language_Feature_Abbreviation_Type );
  procedure SET_QUERY( VALUE :
                          in Statistics_Type );
  procedure SET_QUERY( VALUE :
                          in Version_Type );
--
  function  CATEGORY return Category_Type;
--
  function  VALUE return Architecture_Category_Type;
  function  VALUE return E_and_V_Criterion_Abbreviation_Type;
  function  VALUE return Language_Feature_Abbreviation_Type;
  function  VALUE return Statistics_Type;
  function  VALUE return Version_Type;

end ATTRIBUTE_OPTIONS;

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                  DATABASE.ADA specification:

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with SCHEMA;
use  SCHEMA;
package DATABASE_INTERFACE is
  -----------------------------------------------------------------
  -- Each of the following functions will take as input a test name.
  -- and return as output either a single object or a list of objects
  -- as determined by the specific function called.
  -----------------------------------------------------------------
  function GET_DESCRIPTION( INPUT_NAME : Name_Type)
                                return Description_Type;
  function GET_ARCH_CATEGORY( INPUT_NAME : Name_Type)
                                return Architecture_Category_Type;
  function GET_E_AND_V_CATEGORIES( INPUT_NAME : Name_Type)
                                return E_and_V_Criteria_List;
  function GET_FEATURES( INPUT_NAME : Name_Type)
                                return Language_Features_List;
  function GET_STATISTICS( INPUT_NAME : Name_Type)
                                return Statistics_Type;
  function GET_VERSION( INPUT_NAME : Name_Type)
                                return Version_Type;

  function NAMES( ATTRIBUTE: Architecture_Category_Type)
                                return Name_List;
  function NAMES( ATTRIBUTE: E_and_V_Criterion_Abbreviation_Type)
                                return Name_List;
  function NAMES( ATTRIBUTE: Statistics_Type)
                                return Name_List;
  function NAMES( ATTRIBUTE: Version_Type )
                                return Name_List;
  function NAMES( ATTRIBUTE: Language_Feature_Abbreviation_Type)
                                return Name_List;

  NOT_FOUND,                    -- raised when unit not in database
  CONSISTENCY_ERROR: exception; -- raised when database file
                                --   is corrupted

end DATABASE_INTERFACE;

-  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -

                  CPU_TIME.ADA specification:

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package CPU_TIME is
     function CPU_CLOCK return duration;
end CPU_TIME;

-  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -

                  INQUIRY.ADA specification:

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package INQUIRY_OPERATIONS is

  type Command_Type is (  COLLECT_COMMAND,  SELECT_COMMAND,
                          PRINT_COMMAND,  HELP_COMMAND,
                          SAVE_COMMAND,  LIST_COMMAND,
                          QUIT_COMMAND);

--  ANSWER prompts the user for a Yes-No response, converting the
--            result to type BOOLEAN
--  REQUEST prompts with a menu of choices, converting the
--            result to type Command_Type
--  INITIALIZE prints greeting and initial help info.
--  COLLECT could be called more than once, to change file name setup
--    -- builds Current Files Record and opens Statistics files.
--  SELECT could be called repeatedly, to change selections
--    -- builds Current Options Record
--  LIST could be called out-of-sequence, and repeatedly
--    -- uses built records
--  PRINT dumps the current contents of the statistics files
--  SAVE  prints (a less formatted) version of the Report dialog to
--  a named file
--  HELP re-displays the initial prompt.
--  QUIT closes any open files and exits.
```

```
--
  function REQUEST return Command_Type;
  procedure INITIALIZE;
  procedure COLLECT_FILES;
  procedure SELECT_ATTRIBUTES;
  procedure LIST_STATISTICS;
  procedure PRINT_FILES;
  procedure HELP_PROMPT;
  procedure SAVE_STATISTICS;
  procedure QUIT;

end INQUIRY_OPERATIONS;

- - - - - - - - - - - - - - - - - - - - - - -

                 INSTRUMENT.ADA specification:

- - - - - - - - - - - - - - - - - - - - - - -


package Instrument is
  -- The Instrument routines.
     procedure START          -- THIS ROUTINE MUST BE INVOKED AT THE
                              -- START OF A TEST, BEFORE ANY OF THE
                              -- OTHER REPORT ROUTINES ARE INVOKED.
                              -- IT SAVES THE TEST NAME AND OUTPUTS
                              -- THE NAME AND DESCRIPTION.
        ( NAME : STRING;      -- TEST NAME, E.G., "C23001A-AB".
          DESCR : STRING      -- BRIEF DESCRIPTION OF TEST, E.G.,
                              -- "UPPER/LOWER CASE EQUIVALENCE IN "
                              -- & "IDENTIFIERS".
        );
     procedure COMMENT        -- OUTPUT A COMMENT MESSAGE.
        ( DESCR : STRING      -- THE MESSAGE.
        );
     procedure STOP;          -- THIS ROUTINE MUST BE INVOKED AT THE
                              -- END OF A TEST.  IT OUTPUTS A MESSAGE
                              -- INDICATING WHETHER THE TEST AS A
                              -- WHOLE HAS PASSED OR FAILED, OR IS
                              -- NOT-APPLICABLE.
  -- THE DYNAMIC VALUE ROUTINES.
     -- EVEN WITH STATIC ARGUMENTS, THESE FUNCTIONS WILL HAVE
     -- DYNAMIC RESULTS.
     function IDENT_INT       -- AN IDENTITY FUNCTION FOR TYPE
                              -- INTEGER.
        ( X : INTEGER         -- THE ARGUMENT.
        ) return INTEGER;     -- X.
     function IDENT_CHAR      -- AN IDENTITY FUNCTION FOR TYPE
                              -- CHARACTER.
        ( X : CHARACTER       -- THE ARGUMENT.
        ) return CHARACTER;   -- X.
```

```
         function IDENT_BOOL       -- AN IDENTITY FUNCTION FOR TYPE
                                   -- BOOLEAN.
            ( X : BOOLEAN          -- THE ARGUMENT.
            ) return BOOLEAN;      -- X.
         function IDENT_STR        -- AN IDENTITY FUNCTION FOR TYPE
                                   -- STRING.
            ( X : STRING           -- THE ARGUMENT.
            ) return STRING;       -- X.
         function EQUAL            -- A RECURSIVE EQUALITY FUNCTION FOR
                                   -- TYPE INTEGER.
            ( X, Y : INTEGER       -- THE ARGUMENTS.
            ) return BOOLEAN;      -- X = Y.
--
         generic
           type GEN_TYPE is (<>);
         package PROCS is
           type t is new gen_type;
           type ref_t is access t;
           global: t;
           global_object: t;
           GLOBAL_ACCESS: REF_T := new T;
           INIT: constant T := T'FIRST;
           function IDENT(X: in T) return T;
           procedure LET(X: in out T; Y: T);
         end PROCS;
    --
         generic
           type gen_type is (<>);
           arr_size: integer;
         package arr_procs is
           subtype index is integer range 1..arr_size;
           type t is array(integer range <>) of gen_type;
           init: t(index) := (others => gen_type'first);
           global: t(index);
           function ident(x: t) return t;
           procedure let(x: in out t; y: t);
         end arr_procs;
    end Instrument;
```

```
- - - - - - - - - - - - - - - - - - - - - - -

                  REPORT_WRITER.ADA:

- - - - - - - - - - - - - - - - - - - - - - -
```

```
with INQUIRY_OPERATIONS; use INQUIRY_OPERATIONS;
--  This subprogram acts as the 'main' routine of the portion
--  of the Benchmark system that deals with information
--  retrieval and user interaction.
procedure REPORT_WRITER is
begin
  INITIALIZE;     -- display greeting and helpful prompt
  loop
    case REQUEST is

      when COLLECT_COMMAND => COLLECT_FILES;
           -- set up statistics files

      when SELECT_COMMAND  => SELECT_ATTRIBUTES;
           -- customize display

      when LIST_COMMAND    => LIST_STATISTICS;
           -- display statistics and database attributes

      when SAVE_COMMAND    => SAVE_STATISTICS;
           -- display statistics and database attributes
           -- (to named file)

      when PRINT_COMMAND   => PRINT_FILES;
           -- dump contents of statistics files to screen

      when HELP_COMMAND    => HELP_PROMPT;
           -- display helpful prompt

      when QUIT_COMMAND    => QUIT; exit;
           -- close files

    end case;
  end loop;
end REPORT_WRITER;
```

APPENDIX C: Report Writer's Guide

I. INTRODUCTION

The report writer is used by the Prototype ACEC system to report statistics generated by the host/target system and data supplied with the ACEC. The user carries on an interactive dialog with the report writer via a menu. From this menu, the user can 1) indicate which files are to be used as statistics files, 2) specify both the test attributes to be displayed and the type of database query, and 3) choose to list information either to the terminal or to a file. The remainder of this guide contains specific information on the menu (Section II) and the menu options (Section III). Section IV is an example run of the report writer.

II. MENU

There are seven options present in the report writer's menu. The first option, "C", collects the names of the files to be used as statistics files. The second option, "S", provides for setting the test attributes to be displayed and for changing the database query parameter. Choosing the list option, "L", queries the database using the attributes and parameter set by the second option and lists the desired information to the terminal. Option "P" displays all of the contents of all of the collected statistics files. Not only can the database information be displayed on the terminal, but it can also be put into a data file. This file is specified by using the fifth option, "F". This option acts exactly like the list option except the output is sent to the given file instead of to the screen. If, at any time when the menu is displayed, you need some help, enter "H" to view the short help prompt. Finally, to leave the report writer, select the option "Q", for "quit". When quitting, all opened statistics files are closed and control is returned to the host system.

When the report writer is first executed, and after completing an option (except the QUIT option), the menu is displayed. Only the responses given in the menu are valid. Entering an invalid response will simply cause a reprompt. The responses can be given either in upper- or lower-case characters. The menu is as shown on the following page:

```
- - - - - - - - - - - - - - -

       Valid choices are:
           C    Collect names of statistics files.
           S    Select attributes for reporting.
           L    List selected attributes from files.
           P    Print contents of current files to screen.
           F    Save output to named file.
           H    Re-display help prompt.
           Q    Quit processing.

       Please enter your choice:

- - - - - - - - - - - - - - -
```

III. OPTIONS

Whenever the menu is displayed, entering a valid response will result in a confirmation statement, such as "COLLECT command accepted" for the "C" response. Any values set in an option can be changed and rechanged as many times as necessary while running the report writer.

III.a. COLLECT, "C"

The COLLECT option collects the names of the files to be used as the statistics files. These statistics files are the compilation file, the run time file, and the instrumentation file. At the beginning of a session with the report writer, there are no file names associated with the files; they are "not defined." When this command is invoked, the current status of the statistics files is given. The user can then decide either not to change the status of these files, or to selectively change the status of individual files. After completion of this command, the new file status is given. Below is an example of using this option, where the user wants to change the compilation file to 'c.data', the run time file to 'r.data', and wants to leave the instrumentation file unchanged:

```
- - - - - - - - - - - - - - -

       Please enter your choice: c
       COLLECT command accepted.

      COMPILATION file is not defined.
      RUN_TIME file is not defined.
      INSTRUMENTATION file is not defined.
                                  -- the current files' status
```

```
Do you wish to change file(s)? [y|n]: y
COMPILATION file is not defined. &
                             Do you wish to change? [y|n]: y
File name?: c.data
c.data                   ... open.
                           -- compilation file is now c.data
RUN_TIME file is not defined. &
                             Do you wish to change? [y|n]: y
File name?: r.data
r.data                   ... open.
                             -- run time file is now r.data
INSTRUMENTATION file is not defined. &
                             Do you wish to change? [y|n]: n
COMPILATION file is c.data
RUN_TIME file is r.data                 -- the new status
INSTRUMENTATION file is not defined
```

- - - - - - - - - - - - - - -

The file names given must have six characters. The file must also exist in order to be used by the report writer. However, entering a nonexistant file will not cause a problem:

- - - - - - - - - - - - - - -

```
COMPILATION file is not defined. &
                             Do you wish to change? [y|n]: y
File name?: nofile
nofile      *** File not found
```

- - - - - - - - - - - - - - -

The files collected can be changed or closed by the COLLECT command. Whenever a yes response ("y") is received to the prompt "Do you wish to change? [y|n]", the currently opened statistics file is closed and the user is asked for a file name. To keep that statistics file closed ("not defined"), simply enter a carriage return as the file name. Entering a six character file name will open that file. The file opened will be used as the statistics file. For example, given the three files are currently defined as 'c.data', 'r.data', and 'i.data' respectively, and we want to change the compilation file to 'cl.dat', leave the run time file as is, and close the instrumentation file, the example discourse with the report writer follows:

- - - - - - - - - - - - - - -

```
 Please enter your choice: c
 COLLECT command accepted.
COMPILATION file is c.data
RUN_TIME file is r.data
```

```
    INSTRUMENTATION file is i.data
    Do you wish to change file(s)? [y|n]: y
    COMPILATION file is c.data                   &
                                  Do you wish to change? [y|n]: y
    c.data                      ... closed.File name?:cl.dat
    cl.dat                      ... opened
    RUN_TIME file is r.data                      &
                                  Do you wish to change? [y|n]: n
    INSTRUMENTATION file is i.data               &
                                  Do you wish to change? [y|n]: y
    i.data                      ... closed.File name?:
                                       -- enter a carriage return
    COMPILATION file is cl.dat
    RUN_TIME file is r.data
    INSTRUMENTATION file is not defined
```

- - - - - - - - - - - - - - - -

III.b. SELECT, "S"

The SELECT prompt is used to change the database query and to specify which attributes of the tests are to be displayed. There are two basic database queries. The first is LIST_BY_NAME, and the other is LIST_BY_CATEGORY. The LIST_BY_NAME query is used to gain information about single specific tests. The LIST_BY_CATEGORY query finds all tests that satisfy the category parameter specified. The possible values for the category query are Architecture, E and V Criteria, Language Feature, Version, and Statistic. Under each of these categories are the specific values: Normative performance, Normative capacity, Optional feature, and Optional algorithm are Architecture values. Below is an example of using the SELECT option to change only the database query, with the default list setting and category setting marked:

- - - - - - - - - - - - - - - -

```
    SELECT command accepted.
    Do you wish to change query? [y|n]: y
    Listing setting: LIST_BY_NAME        -- default list setting
    Do you wish to change? [y|n]: y
    Listing setting: LIST_BY_CATEGORY
    Category is: ARCHITECTURE Current Value is EVERY
                                         -- default for category
    Do you wish to change both Category and Value? [y|n]: y
    The choice is one of the following:
        ARCHITECTURE
        E_AND_V
        LANGUAGE_FEATURE
        VERSION
        STATISTICS
```

```
Select the new category as it comes by...

ARCHITECTURE [y|n]: n
E_AND_V [y|n]: y                 -- select the E_AND_V category
Now, select a value as it comes by ...
EFFCY01 [y|n]: n
EFFCY06 [y|n]: y                   -- select the EFFCY06 value
Category is: E_AND_V Current Value is EFFCY06
Do you wish to change display? [y|n]: n
```

- - - - - - - - - - - - - - - -

After specifying the desired query, the user can change the display. If the user requires changes to be made, the first display prompt concerns whether the information for display must be in its long or short form. 'EFFCY01' is the short form of efficiency criteria 01, whereas "Speed of object code generation" is the long form. With the short form, short language feature names and only one header for the various statistics file data are printed. The other questions concern which attributes are to be printed. For all of the attributes, the current setting of the option is given and the user is asked whether to change the current setting or to leave this value unchanged. After all the attributes have been set, the new values of the options are shown. Below is an example, with the default display options marked:

- - - - - - - - - - - - - - - -

```
SELECT command accepted.
Do you wish to change query? [y|n]: n
Do you wish to change display? [y|n]: y
 Display options are:

Attribute: SHORT             Current value is: FALSE
                                                  -- default
                             Do you wish to change? [y|n]: n
Attribute: TEST_NAME
                             Current value is: TRUE
                                                  -- default
                             Do you wish to change? [y|n]: n
Attribute: DESCRIPTION
                             Current value is: TRUE
                                                  -- default
                             Do you wish to change? [y|n]: n
Attribute: ARCHITECTURE
                             Current value is: TRUE
                                                  -- default
                             Do you wish to change? [y|n]: y
                                                  ... changed.
Attribute: E_AND_V           Current value is: TRUE
                                                  -- default
```

```
                                  Do you wish to change? [y|n]: y
                                                       ... changed.
     Attribute: LANGUAGE_FEATURE  Current value is: TRUE
                                                        -- default
                                  Do you wish to change? [y|n]: y
                                                       ... changed.
     Attribute: VERSION           Current value is: TRUE
                                                        -- default
                                  Do you wish to change? [y|n]: n
     Attribute: STATISTICS
                                  Current value is: TRUE
                                                        -- default
                                  Do you wish to change? [y|n]: n
      Display options are:

     Attribute: SHORT             Current value is: FALSE
     Attribute: TEST_NAME         Current value is: TRUE
     Attribute: DESCRIPTION       Current value is: TRUE
     Attribute: ARCHITECTURE      Current value is: FALSE
     Attribute: E_AND_V           Current value is: FALSE
     Attribute: LANGUAGE_FEATURE  Current value is: FALSE
     Attribute: VERSION           Current value is: TRUE
     Attribute: STATISTICS        Current value is: TRUE
```

- - - - - - - - - - - - -

III.c. LIST, "L"

The LIST option is used to query the database. If the query is LIST_BY_NAME, then a 'test unit name' will be asked for. After the test name is received, information about that test is displayed according to the display settings made by the user (or the defaults). For the LIST_BY_CATEGORY query, all entries in the database that satisfy the query will be displayed according to the display settings.

Below are examples of both LIST_BY_NAME and LIST_BY_CATEGORY sessions:

LIST_BY_NAME with display options DESCRIPTION, and STATISTICS and only the compilation statistics file opened.

- - - - - - - - - - - - -

```
      Please enter your choice:  1
     LIST command accepted.
     What is the test unit name? piala2
      Description:            PI Algorithm (test)
      Statistics:             BOTH
     COMPILATION
```

```
 Name             Elapsed/CPU  Code/Data  Comments
PIALA2             14.29  2.10  1536

Do you want to list another unit? [y|n]: y
What is the test unit name? tpitc2
 Description:         Task Performance w/10 Idle Tasks (test)
COMPILATION
 Name             Elapsed/CPU  Code/Data  Comments
TPITC2             18.79  4.56 11776


Do you want to list another unit? [y|n]: y
What is the test unit name? notest
Description:
*** Sorry, NOTEST does not have a database entry
Do you want to list another unit? [y|n]: n
```

- - - - - - - - - - - - -

LIST_BY_CATEGORY with category E_AND_V value EFFCY26 and display options SHORT, TEST_NAME, E_AND_V, and LANGUAGE_FEATURE:

- - - - - - - - - - - - -

```
  Please enter your choice:  1
LIST command accepted.

 Test Name :              ADDSA1
 E and V Criteria:        EFFCY21 EFFCY22 EFFCY01 EFFCY26
 Language Feature(s):     BINARY_ADDS


 Test Name:               ADDSA2
 E and V Criteria:        EFFCY21 EFFCY22 EFFCY01 EFFCY26
 Language Feature(s):     BINARY_ADDS
```

- - - - - - - - - - - - -

III.d. PRINT, "P"

The PRINT option dumps all of the collected statistics files to the screen. If there are no statistics files collected then nothing will be printed to the screen.

III.e. SAVE or FILE, "F"

The "F" option is exactly like the LIST option except that the information extracted from the database is put into a file specified by the user. The file name asked for must be six (6) characters long. At the completion of this command, the specified file will be closed. The following example is just like the LIST example above, where the category was LIST_BY_NAME:

```
- - - - - - - - - - - -

      Please enter your choice:  f
     SAVE command accepted.
     File name?: listed
     listed                 ... open.
     What is the test unit name? piala2
     Do you want to list another unit? [y|n]: y
     What is the test unit name? tpitc2
     Do you want to list another unit? [y|n]: n
     listed                 ... closed.

- - - - - - - - - - - -
```

Here is the file 'listed':

```
- - - - - - - - - - - -

      Description:           PI Algorithm (test)
      Statistics:            BOTH
     COMPILATION
      Name            Elapsed/CPU  Code/Data  Comments
     PIALA2            14.29  2.10  1536


      Description:        Task Performance w/10 Idle Tasks (test)
      Statistics:              BOTH
     COMPILATION
      Name            Elapsed/CPU  Code/Data  Comments
     PIALA2            18.79  4.56 11776

- - - - - - - - - - - -
```

III.f. HELP, "H"

The HELP option re-displays the report writer header.

III.g. QUIT, "Q"

To quit from the report writer, enter the QUIT response to the menu prompt. When quitting, all opened files are closed.

IV. EXAMPLE

Below is an example of running the report writer from beginning to end:

```
- - - - - - - - - - - - -

Initializing Inquiry_Operations.

 There are 3 parameters you can set/change:

1. COLLECT the names of files which contain Statistics
   Then SELECT the Attributes you wish to display.
2. The Query parameter tells the Report Writer how to search the
   Database and Statistics files.
     You can query by Name or by Category.
3. The Display parameter tells what test unit Attributes to display.
   The LIST command produces the Report you've defined.

   Use the PRINT command to see what's in the selected &
                                             Statistics files.
   SAVE is just like List, but lets you put the report in a &
                                                named file for
        later processing in the Host environment.

   You can change Statistics files and Attributes as often as &
                                                     you wish.

 See the User's Manual for details.

Ready to continue? [y|n]: y
 Valid choices are:
      C    Collect names of statistics files.
      S    Select attributes for reporting.
      L    List selected attributes from files.
      P    Print contents of current files to screen.
      F    Save output to named file.
      H    Re-display help prompt.
      Q    Quit processing.

 Please enter your choice: 1
 LIST command accepted.
What is the test unit name? akera2
 Test Name:                AKERA2
 Description:              Ackermann function (test)
 Version:                  TEST
 Architecture Category:    OPTIONAL_ALGORITHM
 E and V Criteria:         Object code size
                           Execution time
                           Speed of object code generation
```

```
  Language Feature(s):   Subprogram Calls
                         Scalar Types, Declarations, and Object &
                                                   Declarations
  Statistics:            BOTH

 Do you want to list another unit? [y|n]: y
 What is the test unit name? sieval
  Test Name:             SIEVA1
  Description:           Sieve of Eratosthenes (control)
  Version:               CONTROL
  Architecture Category: OPTIONAL_ALGORITHM
  E and V Criteria:      Object code size
                         Execution time
                         Speed of object code generation
                         Execution time, arith. & logic opers
  Language Feature(s):   Loop Statements
                         Relational Operators and Membership Tests
                         Binary Adding Operators
  Statistics:            BOTH

 Do you want to list another unit? [y|n]: y
 What is the test unit name? notest
  Test Name:             NOTEST
  Description:
 *** Sorry, NOTEST does not have a Database entry.

 Do you want to list another unit? [y|n]: n
 Valid choices are:
      C    Collect names of statistics files.
      S    Select attributes for reporting.
      L    List selected attributes from files.
      P    Print contents of current files to screen.
      F    Save output to named file.
      H    Re-display help prompt.
      Q    Quit processing.

  Please enter your choice:  j
  ... please try again.
 h
 HELP command accepted.
  There are 3 parameters you can set/change:

 1. COLLECT the names of files which contain Statistics
    Then SELECT the Attributes you wish to display.
 2. The Query parameter tells the Report Writer how to search the
    Database and Statistics files.
      You can query by Name or by Category.
 3. The Display parameter tells what test unit Attributes to display.
    The LIST command produces the Report you've defined.

    Use the PRINT command to see what's in the selected &
                                              Statistics files.
      SAVE is just like List, but lets you put the report in a &
                                                    named file for
           later processing in the Host environment.

      You can change Statistics files and Attributes as often as &
                                                         you wish.

    See the User's Manual for details.

   Ready to continue? [y|n]: y
    Valid choices are:
         C    Collect names of statistics files.
         S    Select attributes for reporting.
         L    List selected attributes from files.
         P    Print contents of current files to screen.
         F    Save output to named file.
         H    Re-display help prompt.
         Q    Quit processing.
    Please enter your choice: c
    COLLECT command accepted.

   COMPILATION file is not defined.
   RUN_TIME file is not defined.
   INSTRUMENTATION file is not defined.
   Do you wish to change file(s)? [y|n]: y
   COMPILATION file is not defined. Do you wish to change? [y|n]: y
   File name?: nofile
   nofile             *** File not found.

   RUN_TIME file is not defined. Do you wish to change? [y|n]: n
   INSTRUMENTATION file is not defined. &
                                   Do you wish to change? [y|n]: n
   COMPILATION file is not defined.
   RUN_TIME file is not defined.
   INSTRUMENTATION file is not defined.

    Valid choices are:
         C    Collect names of statistics files.
         S    Select attributes for reporting.
         L    List selected attributes from files.
         P    Print contents of current files to screen.
         F    Save output to named file.
         H    Re-display help prompt.
         Q    Quit processing.

    Please enter your choice:  c
    COLLECT command accepted.

   COMPILATION file is not defined.
   RUN_TIME file is not defined.
   INSTRUMENTATION file is not defined.
   Do you wish to change file(s)? [y|n]: y
```

```
COMPILATION file is not defined. Do you wish to change? [y|n]: y
File name?: c.data
c.data                      ... open.
RUN_TIME file is not defined. Do you wish to change? [y|n]: y
File name?: r.data
r.data                      ... open.
INSTRUMENTATION file is not defined. &
                                  Do you wish to change? [y|n]: y
File name?: i.data
i.data                      ... open.
COMPILATION file is c.data
RUN_TIME file is r.data
INSTRUMENTATION file is i.data

 Valid choices are:
     C    Collect names of statistics files.
     S    Select attributes for reporting.
     L    List selected attributes from files.
     P    Print contents of current files to screen.
     F    Save output to named file.
     H    Re-display help prompt.
     Q    Quit processing.

 Please enter your choice:  l
LIST command accepted.
What is the test unit name? piala2
 Test Name:                PIALA2
 Description:              PI Algorithm (test)
 Version:                  TEST
 Architecture Category:    OPTIONAL_ALGORITHM
 E and V Criteria:         Speed of object code generation
                           Object code size
                           Execution time
                           Execution time, arith. & logic opers
 Language Feature(s):      Binary Adding Operators
                           Multiplying Operators
                           Highest Precedence Operators
 Statistics:               BOTH
COMPILATION
 Name              Elapsed/CPU  Code/Data  Comments
PIALA2              14.29  2.10  1536

RUN_TIME
 Name   Event      Elapsed/CPU  Code/Data  Comments
PIALA2              11.20  0.18   512   512

INSTRUMENTATION
 Name   Event      Elapsed/CPU             Comments
PIALA2 STOP_REC      0.00  0.00


Do you want to list another unit? [y|n]: y
```

```
What is the test unit name? tpitc2
 Test Name:              TPITC2
 Description:            Task Performance w/10 Idle Tasks (test)
 Version:                TEST
 Architecture Category:  NORMATIVE_PERFORMANCE
 E and V Criteria:       Speed of object code generation
                         Idle task effect on performance
                         Object code size
                         Execution time
 Language Feature(s):    Task Types and Task Objects
                         Task Execution - Task Activation
 Statistics:             BOTH
COMPILATION
 Name             Elapsed/CPU  Code/Data  Comments
TPITC2             18.79  4.56 11776

RUN_TIME
 Name   Event     Elapsed/CPU  Code/Data  Comments
TPITC2             11.77  1.30   512   512

INSTRUMENTATION
 Name   Event     Elapsed/CPU             Comments
TPITC2 STOP_REC     1.36  1.36

Do you want to list another unit? [y|n]: n
 Valid choices are:
     C    Collect names of statistics files.
     S    Select attributes for reporting.
     L    List selected attributes from files.
     P    Print contents of current files to screen.
     F    Save output to named file.
     H    Re-display help prompt.
     Q    Quit processing.

 Please enter your choice:  s
SELECT command accepted.
Do you wish to change query? [y|n]: y
Listing setting: LIST_BY_NAME
Do you wish to change? [y|n]: y
Listing setting: LIST_BY_CATEGORY
Category is: ARCHITECTURE Current Value is EVERY
Do you wish to change both Category and Value? [y|n]: y
The choice is one of the following:
    ARCHITECTURE
    E_AND_V
    LANGUAGE_FEATURE
    VERSION
    STATISTICS
Select the new category as it comes by...

ARCHITECTURE [y|n]: n
E_AND_V [y|n]: y
```

```
Now, select a value as it comes by ...
EFFCY01 [y|n]: n
EFFCY06 [y|n]: n
EFFCY13 [y|n]: n
EFFCY18 [y|n]: n
EFFCY21 [y|n]: n
EFFCY22 [y|n]: n
EFFCY26 [y|n]: y
Category is: E_AND_V Current Value is EFFCY26
Do you wish to change display? [y|n]: y
 Display options are:

Attribute: SHORT             Current value is: FALSE
                             Do you wish to change? [y|n]: y
                                                 ... changed.
Attribute: TEST_NAME         Current value is: TRUE
                             Do you wish to change? [y|n]: y
                                                 ... changed.
Attribute: DESCRIPTION       Current value is: TRUE
                             Do you wish to change? [y|n]: y
                                                 ... changed.
Attribute: ARCHITECTURE      Current value is: TRUE
                             Do you wish to change? [y|n]: n
Attribute: E_AND_V
                             Current value is: TRUE
                             Do you wish to change? [y|n]: n
Attribute: LANGUAGE_FEATURE
                             Current value is: TRUE
                             Do you wish to change? [y|n]: n
Attribute: VERSION
                             Current value is: TRUE
                             Do you wish to change? [y|n]: y
                                                 ... changed.
Attribute: STATISTICS        Current value is: TRUE
                             Do you wish to change? [y|n]: n
Display options are:

Attribute: SHORT             Current value is: TRUE
Attribute: TEST_NAME         Current value is: FALSE
Attribute: DESCRIPTION       Current value is: FALSE
Attribute: ARCHITECTURE      Current value is: TRUE
Attribute: E_AND_V           Current value is: TRUE
Attribute: LANGUAGE_FEATURE  Current value is: TRUE
Attribute: VERSION           Current value is: FALSE
Attribute: STATISTICS        Current value is: TRUE

 Valid choices are:
     C    Collect names of statistics files.
     S    Select attributes for reporting.
     L    List selected attributes from files.
     P    Print contents of current files to screen.
     F    Save output to named file.
     H    Re-display help prompt.
     Q    Quit processing.

 Please enter your choice:  1
LIST command accepted.

 Architecture Category: NORMATIVE_PERFORMANCE
 E and V Criteria:       EFFCY21 EFFCY22 EFFCY01 EFFCY26
 Language Feature(s):    BINARY_ADDS
 Name   Event    Elapsed/CPU  Code/Data  Comments
ADDSA1             16.74  2.30  1536

ADDSA1             13.23  0.30   512   512

ADDSA1 STOP_REC     0.16  0.16


 Architecture Category: NORMATIVE_PERFORMANCE
 E and V Criteria:       EFFCY21 EFFCY22 EFFCY01 EFFCY26
 Language Feature(s):    BINARY_ADDS
 Name   Event    Elapsed/CPU  Code/Data  Comments
ADDSA2             28.50  1.95  1536

ADDSA2             11.71  0.28   512   512

ADDSA2 STOP_REC     0.23  0.23


 Architecture Category: NORMATIVE_PERFORMANCE
 E and V Criteria:       EFFCY21 EFFCY22 EFFCY01 EFFCY06 EFFCY29 &
                                                         EFFCY26
 Language Feature(s):    BINARY_ADDS PRAGMA_SUPPRESS
 Name   Event    Elapsed/CPU  Code/Data  Comments
ADDSA3             28.99  2.10  1536

ADDSA3             11.89  0.30   512   512

ADDSA3 STOP_REC     0.11  0.11


 Architecture Category: NORMATIVE_PERFORMANCE
 E and V Criteria:       EFFCY21 EFFCY22 EFFCY01 EFFCY26
 Language Feature(s):    MULTIPLYING_OPS
 Name   Event    Elapsed/CPU  Code/Data  Comments
MULTA1             15.00  1.85  1536

MULTA1             11.20  0.28   512   512

MULTA1 STOP_REC     0.08  0.08
```

```
--  many database responses have been deleted from this example.
--     There were a lot of them.

 Valid choices are:
     C    Collect names of statistics files.
     S    Select attributes for reporting.
     L    List selected attributes from files.
     P    Print contents of current files to screen.
     F    Save output to named file.
     H    Re-display help prompt.
     Q    Quit processing.

 Please enter your choice:  c
COLLECT command accepted.

COMPILATION file is c.data
RUN_TIME file is r.data
INSTRUMENTATION file is i.data
Do you wish to change file(s)? [y|n]: y
COMPILATION file is c.data                &
                                Do you wish to change? [y|n]: y
c.data                   ... closed.File name?:
RUN_TIME file is r.data                   &
                                Do you wish to change? [y|n]: y
r.data                   ... closed.File name?:
INSTRUMENTATION file is i.data            &
                                Do you wish to change? [y|n]: n
COMPILATION file is not defined.
RUN_TIME file is not defined.
INSTRUMENTATION file is i.data

 Valid choices are:
     C    Collect names of statistics files.
     S    Select attributes for reporting.
     L    List selected attributes from files.
     P    Print contents of current files to screen.
     F    Save output to named file.
     H    Re-display help prompt.
     Q    Quit processing.

 Please enter your choice:  s
SELECT command accepted.
Do you wish to change query? [y|n]: y
Listing setting: LIST_BY_CATEGORY
Do you wish to change? [y|n]: y
Listing setting: LIST_BY_NAME
Do you wish to change display? [y|n]: y
 Display options are:

Attribute: SHORT             Current value is: TRUE
                             Do you wish to change? [y|n]: n
```

```
Attribute: TEST_NAME
                             Current value is: FALSE
                             Do you wish to change? [y|n]: n
Attribute: DESCRIPTION
                             Current value is: FALSE
                             Do you wish to change? [y|n]: n
Attribute: ARCHITECTURE
                             Current value is: TRUE
                             Do you wish to change? [y|n]: y
                                                 ... changed.
Attribute: E_AND_V           Current value is: TRUE
                             Do you wish to change? [y|n]: y
                                                 ... changed.
Attribute: LANGUAGE_FEATURE  Current value is: TRUE
                             Do you wish to change? [y|n]: y
                                                 ... changed.
Attribute: VERSION           Current value is: FALSE
                             Do you wish to change? [y|n]: n
Attribute: STATISTICS
                             Current value is: TRUE
                             Do you wish to change? [y|n]: n
 Display options are:

Attribute: SHORT             Current value is: TRUE
Attribute: TEST_NAME         Current value is: FALSE
Attribute: DESCRIPTION       Current value is: FALSE
Attribute: ARCHITECTURE      Current value is: FALSE
Attribute: E_AND_V           Current value is: FALSE
Attribute: LANGUAGE_FEATURE  Current value is: FALSE
Attribute: VERSION           Current value is: FALSE
Attribute: STATISTICS        Current value is: TRUE

 Valid choices are:
     C    Collect names of statistics files.
     S    Select attributes for reporting.
     L    List selected attributes from files.
     P    Print contents of current files to screen.
     F    Save output to named file.
     H    Re-display help prompt.
     Q    Quit processing.

 Please enter your choice:  1
LIST command accepted.
What is the test unit name? addsa1
 Name   Event    Elapsed/CPU  Code/Data  Comments
ADDSA1 STOP_REC    0.16  0.16


Do you want to list another unit? [y|n]: y
What is the test unit name? addsa2
 Name   Event    Elapsed/CPU  Code/Data  Comments
ADDSA2 STOP_REC    0.23  0.23
```

```
Do you want to list another unit? [y|n]: n
 Valid choices are:
     C    Collect names of statistics files.
     S    Select attributes for reporting.
     L    List selected attributes from files.
     P    Print contents of current files to screen.
     F    Save output to named file.
     H    Re-display help prompt.
     Q    Quit processing.

 Please enter your choice:  f
SAVE command accepted.
File name?: listed
listed                  ... open.
What is the test unit name? addsa1
Do you want to list another unit? [y|n]: y
What is the test unit name? addsa2
Do you want to list another unit? [y|n]: n
listed                  ... closed.
 Valid choices are:
     C    Collect names of statistics files.
     S    Select attributes for reporting.
     L    List selected attributes from files.
     P    Print contents of current files to screen.
     F    Save output to named file.
     H    Re-display help prompt.
     Q    Quit processing.
 Please enter your choice:  q
QUIT command accepted.


i.data                  ... closed.

-- Below is the file 'listed'.

 Name   Event    Elapsed/CPU  Code/Data  Comments
ADDSA1 STOP_REC    0.16  0.16



 Name   Event    Elapsed/CPU  Code/Data  Comments
ADDSA2 STOP_REC    0.23  0.23

- - - - - - - - - - - - -
```

APPENDIX D : EXECUTION EXAMPLES

DATA GENERAL MV 10000:

Below is the test harness. Examples of the input and output files will follow. In the following command procedures,

& is a line continuation character,
%n% is a symbol for the n-th parameter passed to the command,
[file] is an expansion symbol, so that this symbol is expanded to the contents of the named file, and
:udd:f.n is a sample pathname for a file.

Note that naming a file as a command requests that the file name requested, plus a ".cli" on the end, is used as further input to the command line interpreter at that point in the command file.

The following is ":udd:benchmarks:harness_many.cli", the main command file. This command file creates the compilation statistics and run-time statistics files, in that order, and batches a job to generate the statistics. The batch command runs onto a second line, as indicated by the "&".

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

     create harness.out
     create instr.dat
     qbatch/qpri=101/qoutput=%1%.log/notify &
     :udd:benchmarks:harness_a %1%

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

The following is :udd:benchmarks:harness_a.cli, called from the file above. This file is useful only to insure that only one Ada compilation or execution is being created by this set of command files at a time.

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

     :udd:benchmarks:harness [%1%]

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

The following is :udd:benchmarks:harness.cli, which contains all the commands for a single test job. Harness first records the name of the test on the temporary statistics file (%1%.stat). Next it records the current (elapsed) time and the amount of CPU time used so far by this process. After compiling and linking the test file, the current time and amount of CPU time used are recorded again; the execution time statistics will be derived from this information. After a fifteen second pause, the size of the produced load image is recorded on the temporary statistics file (by a little program called "HFORMAT", designed for that purpose). The collected statistics are then appended to the enduring statistics file, and the temporary compilation statistics file is deleted. Lastly, the test program is run, the statistics produced by the instrumentation package are appended to the enduring instrumentation statistics file, and the temporary statistics file is deleted.

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

     write/l=%1%.stat %1%
     runtime/l=%1%.stat
     ada/main remakes:%1-%
     adalink %1%
     runtime/l=%1%.stat
     pause 15
     fi/length/nheader/l=%1%.stat %1%.pr
     x :udd:benchmarks:hformat %1%.stat %1%.stats
     copy/a harness.out %1%.stats
     delete %1%.stats
     x %1%
     copy/a/l=warning/2=warning instr.dat instr
     delete instr

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

Here is a sample input file to the test harness for the AOS/VS system. The test harness would be executed with the command "harness_many input.file" where the file "input.file" is shown below. The parentheses and ampersands are part of the AOS/VS command line syntax, which allow the processing of each listed test in turn.

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

     (ADDSA1 &
     ADDSA2 &
     ADDSA3)

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

Below is the generated file "harness.out", which is the compilation statistics file for the input listed above.

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

     ADDSA1               254.000                  5.069 319488
     ADDSA2               375.000                  5.071 319488
     ADDSA3               650.000                  5.023 319488

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

Below is the generated file "instr.dat", which is the file containing the instrumentation statistics collected during the run for the input above. Note that the lines have been broken to fit in this manual; the "&" is used as a continuation character.

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

     ADDSA1 START_REC         0.000        0.000 &
                        ADD PROGRAM, CONTROL VERSION - 10_000 ADDS
     ADDSA1 STOP_REC         0.301        0.301
     ADDSA2 START_REC         0.000        0.000 &
                        ADD PROGRAM, W/O PRAGMAS - 10_000 ADDS
     ADDSA2 STOP_REC         0.400        0.400
     ADDSA3 START_REC         0.000        0.000 &
                        ADD PROGRAM, WITH PRAGMAS - 10_000 ADDS
     ADDSA3 STOP_REC         0.201        0.201

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

VAX/VMS:

The following is 'USW:[BENCHMARK.WORK]HARNESS_MANY.COM', the main command file:

- -

```
$!  This VAX/VMS command file loops through a file
$!    containing ADA source benchmark test file names and
$!    submits them to the test harness for the collection of
$!    the various statistics.  For this implementation, this
$!    COM file must be submitted as a batch job.
$!
$!  The name of the file containing the test names is given as
$!    the first parameter to this command procedure.
$!
$!  The second parameter is the directory in which these tests
$!    must reside.
$!
$!
$! Set the default ADA library
$!
$ acs set lib usw:[benchmark.mike.adalib]
$!
$! Set the default directory to usw:[benchmark.work]
$!
$ set def usw:[benchmark.work]
$!
$! Create the three statistic files
$!
$     create comp.dat
$     create instr.dat
$     create run.dat
$!
$! Open the file with the test names
$!
$     open/read in_file 'p1'
$!
$! Loop through  the file of tests,  submitting each test to
$!    the  harness for the collection of the various data.
$!
$ loop:
$     read/end_of_file=done in_file test
$     @harness 'test' 'p2'
$     goto loop
$!
$! At the end of the input file, close the file and
$!    terminate this command procedure.
$!
$ done:
$    close in_file
$    write sys$output "All tests have been submitted for testing"
```

Below is the command file that is executed by 'HARNESS_MANY.COM'. This file's name is 'USW:[BENCHMARK.WORK]HARNESS.COM'.

```
$! This VAX/VMS command file performs functions necessary to
$!    collect various data about ADA source test files.
$!    These data are put into the  files  'comp.dat'
$!    (compilation  statistics), 'instr.dat'
$!    (instrumentation statistics) and 'run.dat' (run-time
$!    statistics).
$!
$! Record the current elapsed and cpu times (before
$!    compilation)
$!
$ beg_cpu_time = f$getjpi("","cputim")
$ beg_time = f$time()
$!
$! Compile and link the test
$!
$ ada/nocopy_source 'p2''p1'
$ acs link 'p1'
$!
$! Record the current elapsed and cpu times (after
$!    compilation)
$!
$ end_cpu_time = f$getjpi("","cputim")
$ end_time = f$time()
$!
$! 'file' => file_spec of the object file created by the
$!    compilation
$!
$ file = "usw:[benchmark.mike.adalib]" + p1 + ".obj"
$!
$! Calculate the number of bytes in the object file
$!
$ blocks_used = f$file_attributes(file,"eof")
$ block_size  = f$file_attributes(file,"bls")
$ file_size = blocks_used * block_size
$!
$! Calculate elapsed cpu time ( in hundredths of seconds )
$!
$ cpu_time = (end_cpu_time - beg_cpu_time)
$!
$! Divide the elapsed cpu time into seconds and
$!    hundredths-seconds
$!
$ cpu_time_secs = cpu_time / 100
$ cpu_time_hundsecs = cpu_time - 100 * cpu_time_secs
```

```
$!
$! Calculate elapsed time
$!  The COM  file 'calc_elapsed_time' takes the 'beg_time'
$!    and 'end_time' and returns the elapsed time in its
$!    seconds and hundredths seconds parts.  These values are
$!    placed in the global symbol table and have symbol names
$!    'elapsed_time_secs' and 'elapsed_time_hundsecs'.
$!
$ @calc_elapsed_time "''beg_time'" "''end_time'"
$!
$! Put the compilation statistics in one output line
$!
$ out_line ="''p1'  ''elapsed_time_secs'." + -
    "''elapsed_time_hundsecs'  " + -
    "''cpu_time_secs'.''cpu_time_hundsecs'  ''file_size'"
$!
$! Append the output line onto the file
$!
$ open/append comp comp.dat
$ write comp out_line
$ close comp
$!
$! Record the current elapsed and cpu times (before
$!    execution)
$!
$ beg_cpu_time = f$getjpi("","cputim")
$ beg_time = f$time()
$!
$! Run the executable file
$!
$ run 'p1'.exe
$!
$! Record the current elapsed and cpu times (after execution)
$!
$ end_cpu_time = f$getjpi("","cputim")
$ end_time = f$time()
$!
$! Append the instrumentation statistics to instr.dat
$!
$ append instr.; instr.dat
$!
$! Calculate elapsed cpu time ( in hundredths of seconds )
$!
$ cpu_time = (end_cpu_time - beg_cpu_time)
$!
$! Divide the elapsed cpu time into seconds and
$!    hundredths-seconds
$!
$ cpu_time_secs = cpu_time / 100
$ cpu_time_hundsecs = cpu_time - 100 * cpu_time_secs
```

```
$!
$! Calculate elapsed time
$!
$ @calc_elapsed_time "''beg_time'" "''end_time'"
$!
$! Put the available execution statistics in one output line
$!
$ out_line ="''p1'  ''elapsed_time_secs'." + -
      "''elapsed_time_hundsecs'  " + -
      "''cpu_time_secs'.''cpu_time_hundsecs'  512  512"
$!
$! Append the output line onto the file
$!
$ open/append run run.dat
$ write run out_line
$ close run
$!
$! Delete unnecessary files
$!
$ del instr.;*
$ delete 'p1'.exe.*
$ acs delete unit 'p1'
```

- -

Here is the file 'USW:[BENCHMARK.WORK]CALC_ELAPSED_TIME.COM':

- -

```
$! Calculate the elapsed time between the beginning time and
$!    the ending time (the first and second parameters).
$!    The times are given in the VAX/VMS format.  The two
$!    times are assumed to be less than 24 hours apart!
$!
$!
$! Disect the beginning time (first parameter) into time
$!    units
$!
$ beg_hs  = f$extract(21,2,p1)  ! hundredths of seconds
$ beg_sec = f$extract(18,2,p1)  ! seconds
$ beg_min = f$extract(15,2,p1)  ! minutes
$ beg_hr  = f$extract(12,2,p1)  ! hours
$!
$! Disect the ending time (second parameter) into time units
$!
$ end_hs  = f$extract(21,2,p2)  ! hundredths of seconds
$ end_sec = f$extract(18,2,p2)  ! seconds
$ end_min = f$extract(15,2,p2)  ! minutes
$ end_hr  = f$extract(12,2,p2)  ! hours
$!
$! Convert each of the times to hundredths of seconds
$!
```

```
$ beg_time = -
  (((beg_hr * 60) + beg_min) * 60 + beg_sec ) * 100 + beg_hs
$ end_time = -
  (((end_hr * 60) + end_min) * 60 + end_sec ) * 100 + end_hs
$!
$! Get the total elapsed time ( in hundredths of seconds )
$!
$ total_time = end_time - beg_time
$!
$! If the total time is negative then the beginning and end
$!    times were on different days.
$!
$ if total_time .lt. 0 then -
   total_time = (((24 * 60) * 60) * 100) + end_time - beg_time
$!
$! Seperate the elapsed time into seconds and hundredths of
$!    seconds
$!
$ total_time_secs = total_time / 100
$ total_time_hundsecs = total_time - total_time_secs * 100
$!
$! Put the elapsed time in the global symbol table, so that
$!    it can be accessed.
$!
$ elapsed_time_secs ==  total_time_secs
$ elapsed_time_hundsecs == total_time_hundsecs
$!
$ exit
```

- -

Here is an example of an input file to the 'HARNESS_MANY' COM file:

- -

```
CAPAA1
CAPAA2
NRPCA1
NRPCA2
```

- -

The format of this file must be as given above in order to use these COM files. No file type is given on the file names; however, they must be of type '.ADA' in their resident directory.

The main COM file would be executed with the command

```
"$ submit HARNESS_MANY/parameters=(file_spec, dir_spec) -
          /queue=big"
```

where 'file_spec' is the VAX/VMS file specification of the file containing the names of the tests and 'dir_spec' is the directory specification of the directory containing the tests.

Here is an example of executing the main COM file, and the system messages received:

```
$ submit harness_many/parameters=(new.lst,usw:[benchmark.new]) -

    /queue=big

Job HARNESS_MANY (queue BIG entry 355) started on BIG

Job HARNESS_MANY (queue BIG entry 355) completed
```

Below is the file 'comp.dat', which is the compilation statistics file generated for the input file above.

```
CAPAA1  22.76  3.64  3584
CAPAA2  19.6  3.85  3584
NRPCA1  20.26  3.73  4096
NRPCA2  19.28  3.79  4096
```

Below is the generated file 'run.dat' with the run-time statistics for the input file given above. NOTE: The last two numbers do not mean anything; they are there simply to make the format of the execution statistics file what is expected by the Report Writer.

```
CAPAA1  11.95  0.21  512  512
CAPAA2  12.23  0.24  512  512
NRPCA1  11.15  0.24  512  512
NRPCA2  10.93  0.20  512  512
```

Below is the file 'instr.dat', containing instrumentation statistics generated for the input file above. Lines too long to fit in the manual are denoted by the '&', and continued on the next line.

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

CAPAA1 START_REC      0.0000       0.0000  &
       Constrained Array Param. Assoc. w/3 elements (Control)
CAPAA1 STOP_REC      0.0300       0.0300
CAPAA2 START_REC      0.0000       0.0000  &
       Constrained Array Param. Assoc. w/3 elements (test)
CAPAA2 STOP_REC      0.0300       0.0300
NRPCA1 START_REC      0.0000       0.0000  &
       Nested Recursive Procedure Call (Control)
NRPCA1 STOP_REC      0.0500       0.0500
NRPCA2 START_REC      0.0000       0.0000  &
       Nested Recursive Procedure Call (Test)

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

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